WHOI-2020-01

Woods Hole Oceanographic Institution

The Deep Water Dispersion Experiment: RAFOS Float Data Report June 2016 - January 2019

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Andrée L. Ramsey, Heather H. Furey, Amy S. Bower, Paula Pérez Brunius, and Paula Garcia Carrillo

December 2019

Technical Report

Funding was provided by the Mexican National Council for Science and Technology - Mexican Ministry of Energy - Hydrocarbon Fund, project 201441. This work was completed through a contract by the Center for Scientific Research and Higher Education at Ensenada (CICESE) under Grant No. 188355 to the Woods Hole Oceanographic Institution.

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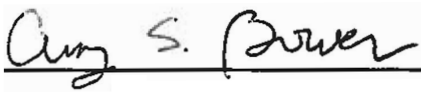

Amy Bower, Chair

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ABSTRACT

This is the final data report for all acoustically-tracked subsurface RAFOS floats deployed for the “Deep Water Dispersion Experiment: RAFOS Float Study in Support of Analysis of Possible Consequences of Large Scale Oil-Spills under Various Scenarios” (DWDE). This study is part of the larger program “Deep and Shallow Particle Dispersion and Biological Connectivity over the Continental Slope in the Western Gulf of Mexico”, of the Gulf of Mexico Research Consortium (CIGoM). The objective of the DWDE project was to measure and evaluate the ocean circulation at various depths in order to estimate the rates and pathways by which a passive tracer (e.g. pollutant, nutrients, etc.) would spread. The experiment consisted of the deployment 93 RAFOS floats and five sound source moorings (needed for tracking the floats underwater) over the course of five cruises, between June 2016 and January 2019, in the Perdido region of the Gulf of Mexico. The floats were deployed nearly simultaneously at stacked depths of 300 and 1500 dbar, in sets of 2-4 instruments per station, for calculating dispersion statistics. Mission lengths for the floats were set to ~12 to 18 months. Included in this report are cruise summaries, statistics and notes on sound source and float performance, sound source drift calculations, description of the RAFOS float data processing steps, and figures.

INTRODUCTION

The Gulf of Mexico Research Consortium (CIGoM) commissioned a study to analyze the physical transport and dispersion processes in the Perdido (northwestern) region of the Gulf of Mexico. The "RAFOS Float Study in Support Analysis of Possible Consequences of Large Scale Oil-Spills under Various Scenarios" was part of the larger program "Deep and Shallow Particle Dispersion and Biological Connectivity over the Continental Slope in the Western Gulf of Mexico". The long-term goal was to better understand potential consequences of an oil spill in the deep waters of the region.

Evaluating ocean circulation is critical to estimating the path of passive tracers, and assessing the impact on biological and ecological processes of an ecosystem. Plans are being made to extract oil in the Perdido region in the coming years. Before drilling occurs, it is critical to be able to better predict pollutant transport at the sea surface and throughout the water column in order to facilitate cleanup and reduce damage to ecological system in the unfortunate event of a large-scale oil spill. The high resolution data of small-scale ocean features using RAFOS floats can be used to improve the predictive capability of high-resolution ocean circulation models. The model results can be used for predicting what may happen in other areas of the Gulf of Mexico as well.

The Gulf of Mexico is often characterized as a two-layer circulation system (e.g., Hamilton et al., 2018). In order to capture the full water column synoptic circulation, deployments of subsurface RAFOS floats were coordinated with surface drifter deployments (part of another project under the same funding program), so that the surface, upper layer (from the surface to ~1000m), and lower layer (from ~1000m to the seafloor) were all sampled simultaneously. The surface drifters and subsurface floats were deployed in sets of 2-4 instruments so that dispersion statistics could be estimated.

The original experimental plan consisted of deploying 90 RAFOS subsurface floats, in groups of 22-23 every spring and fall for two years at 300 and 1500 dbar (equivalent to 297-m and 1496-m depths, Figure 1). The floats were deployed in a ~200 km long section oriented perpendicular to the shelf at about 25°N (Figure 2, Figure 3). The missions ranged between 300 to 540 days (10 to 18 months). The floats were programmed to record water property data and times-of-arrival signals from sound sources three times per day. This frequency of positioning was chosen specifically to resolve mesoscale current variability, as the inertial period in the Gulf of Mexico ranges from 28-38 hours. The floats were tracked using an array of five moored sound sources

positioned at approximately 900m depth, at the sound speed minimum in the Gulf of Mexico, which ranges in depth between 800 and 1000m (Figure 4).

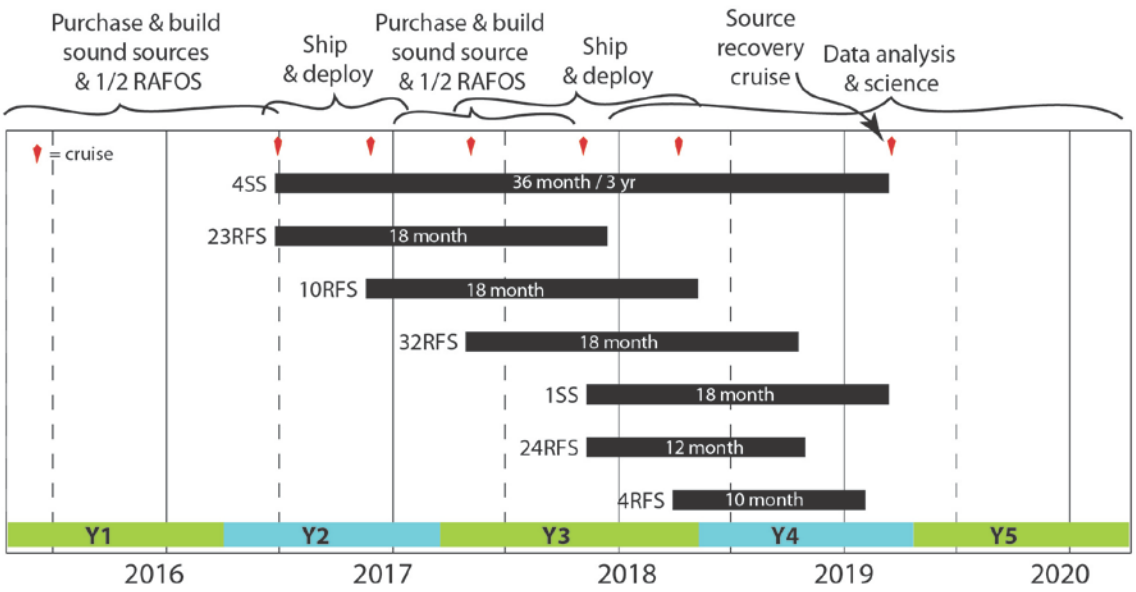

FIGURE 1 EXPERIMENT TIMELINE

'SS' denotes sound source mooring deployment, 'RFS' denotes RAFOS float deployment. The original deployment schedule consisted of only one sound source deployment cruise, and four float deployment cruises. An additional sound source and float deployment cruise was added after the project began.

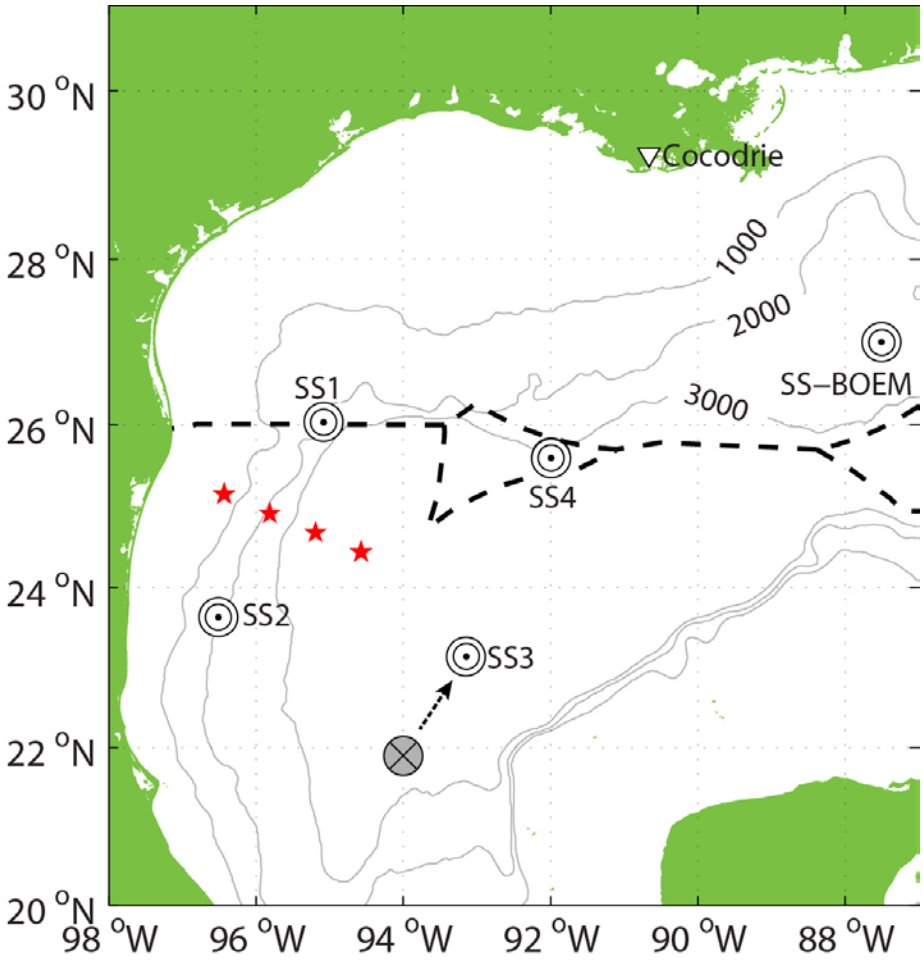

FIGURE 2 PROPOSED EXPERIMENT DESIGN

Proposed experiment design for the DWDE RAFOS and sound source mooring deployments. The triangle marker at Cocodrie, Louisiana marks the homeport of the *R/V Pelican*, the ship used for the majority of the field program. Circle markers show sound source locations. The grayed marker shows the planned position of sound source 3, and dashed arrow shows the actual position due to weather constraints during the deployment cruise. The position of a remnant sound source from a previous RAFOS float project, 'SS-BOEM', is also marked, as the acoustic signals from that source were also recorded by the floats, and can be seen in Appendix J. The thick dashed line marks the Exclusive Economic zone (EEZ) boundaries and red stars show the proposed deployment locations for the RAFOS floats.

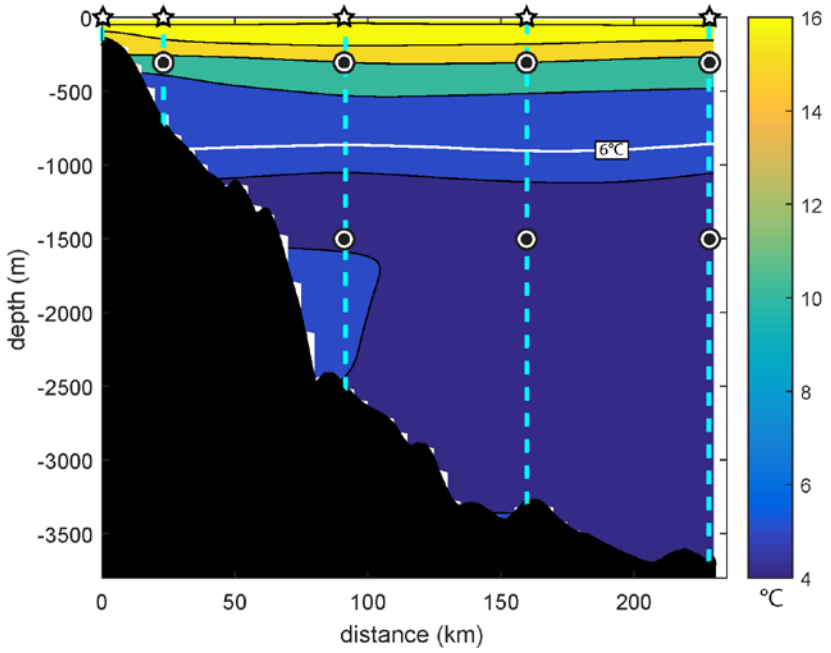

FIGURE 3 SURFACE DRIFTER AND RAFOS FLOAT NOMINAL DEPLOYMENT LOCATIONS

Surface drifter (star) and RAFOS float (double-circle) nominal deployment locations plotted over the cross-shelf section of DWDE-1 conservative temperature (TEOS-10). Both surface drifters, which were deployed as part of a companion project, and RAFOS floats, were deployed in groups of 2-4 instruments and in vertical 'stacks' where two or three levels of the water column were seeded at the same position, depending on water depth. The 6°C isotherm is contoured in white, and represents the division between upper and lower layer flow fields in the Gulf of Mexico, as defined by Hamilton et al. (2018). Temperature is contoured every 2°C. Dashed vertical lines mark the CTD station locations. Bathymetry across the shelf has been interpolated from ETOPO2.

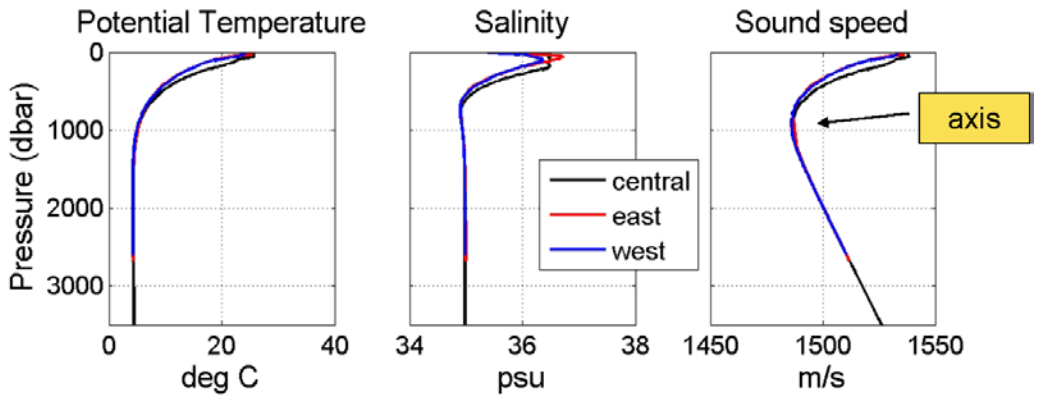

FIGURE 4 HYDROGRAPHIC PROPERTIES FOR STUDY AREA

Hydrographic property profiles, including sound speed, for the west, central and eastern Gulf of Mexico. The sound channel axis (minimum in sound speed) is labelled.

RAFOS Floats and the Sound Source Array

The Ranging and Fixing of Sound (RAFOS) float is an acoustically-tracked subsurface Lagrangian drifter programmed to listen for signals from moored sound sources at scheduled intervals. The floats are designed to passively drift at a fixed pressure, recording hydrographic properties of temperature and pressure, and acoustic times-of-arrival (TOAs) and correlations from sound source signals at scheduled time intervals. They are equipped with a thermistor, pressure sensor, internal clock, hydrophone, and an Iridium antenna. Once the float's mission is complete, it is programmed to send an electrical signal through the external burn wire, causing the drop weight to release from the float. The float, suddenly positively buoyant, proceeds to rise to the surface. Once at the surface, it sends the data collected for the entire mission via the Iridium satellite system, to be processed and tracked. See Rossby et al. (1986) for a comprehensive description of the RAFOS system.

The 260 Hz sound sources used in this experiment emit an 80-second long swept frequency signal, from 259.38 to 260.90 Hz, at the 'pong time' assigned to each of the sound sources. These pong times were scheduled to be ~15 minutes apart so that acoustic signals from the individual sources did not overlap during the float's listening window.

The floats were programmed to open a listening window every eight hours, bracketing the time span in which sound sources were scheduled to pong, recording the TOA and correlation value of the acoustic signal from the sound source as measured by the hydrophone. The correlation values indicate how well the 80-second swept signal received by the float matched the signal sent by the sound source. The floats were set to record the six best correlated TOAs during each listening window. At the end of the listening window, in this case 90 minutes, temperature and pressure were also recorded.

The RAFOS floats used for this project were purchased from Seascan, Inc. in Falmouth, Massachusetts, USA. Twelve of the DWDE-1 floats were ballasted at the University of Rhode Island's Graduate School of Oceanography Ballast Facility, using the strain gauge method, and overseen by URI engineer James Fontaine [float serial numbers [1462 1463 1467 1468 1480 1481 1483 1488 1489 1490 1491 1494]. The remaining project floats were ballasted at Woods Hole Oceanographic Institution under the supervision of WHOI engineer James Valdes. All floats had their weights adjusted, were calibrated, tested, and programmed at Woods Hole Oceanographic Institution, also under the supervision

of James Valdes. Iridium service was provided by MetOcean Telematics in Dartmouth, Nova Scotia, Canada.

Four of the sound sources [D2-D5] were built at WHOI using the WHOI-URI design, by James Valdes. One sound source [D1] was lent to the DWDE program from the existing inventory of the Bower Lab, and had been built at Teledyne Webb Research (Falmouth, MA, USA) using the Webb design. All the sound sources were calibrated and programmed at WHOI by James Valdes. The sound sources were tuned to the mean water properties specific to the area using the HydroBase 3.0 data base and all available Argo profile data (Figure 4 as an example).

Deployment and Recovery Cruises

The initial plan was to deploy four sound sources and 90 floats during four cruises in groups of 22-23 every spring and fall over the course of two years. By the end of the project, one sound source mooring, two RAFOS floats, and an extra deployment of RAFOS floats aboard a cruise of opportunity had been added (Figure 1). The cruises took place in June 2016, October 2016, April 2017, November 2017, and March 2018. In practice, a total of 93 floats were deployed as part of this program: 90 purchased specifically for DWDE, one re-deployed after it completed its science mission, and two donated by the Bower Lab from existing inventory.

FIGURE 5 FLOAT PERFORMANCE CHART

Each bar indicates the underwater mission length of a float; serial numbers noted at the left of each bar. The notation 'DNS-' indicates 'Did Not Surface' and 'M-' indicates 'Monitor Float'. The histogram bars are color coded by float target pressure: Gray/Black indicates a 300 /1500 dbar target pressure.

Of the 93 floats deployed, seven floats never surfaced or transmitted data; six of these were presumably damaged or destroyed by sharkbite, discussed below. Six of the floats were used as monitor floats, programmed with short mission lengths (2-day, 30-day, 120-day, 127-day) and were used to check sound source array performance at different stages of the field program. Further details and explanations of the adjustments will be discussed in the following subsections. Figure 5 shows the staggered start times of the five RAFOS deployments, and visually depicts the duration of the float data collection periods.

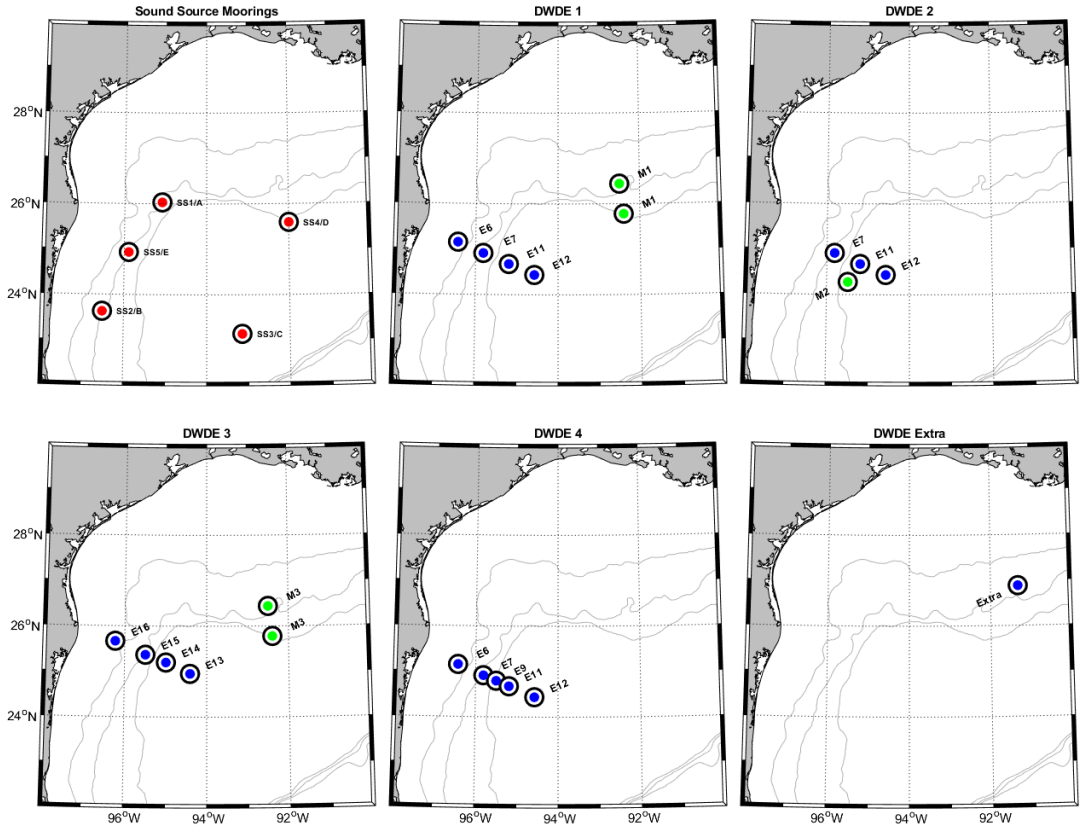

FIGURE 6 FLOAT AND SOUND SOURCE DEPLOYMENT LOCATIONS
Deployment locations for science floats (blue dots), monitor floats (green dots), and sound sources (red dots).

DWDE-1 June 19-23, 2016 R/V Pelican

The first cruise, DWDE-1, occurred during June 19-23, 2016 aboard the *R/V Pelican*. The cruise plan was to first deploy the four sound source moorings (Figure 6). Sound sources D1, D2, and D4 were deployed as planned. Due the effects of Tropical Storm Danielle on

the weather conditions, the location for the sound source D3 was moved northeast of its planned location and therefore was located 109-m deeper in the water column (Figure 2). This depth change did not affect signal quality.

A total of 23 RAFOS floats were deployed (two monitor floats and 21 full mission floats), distributed between four stations (Figure 6). The monitor float mission lengths were 30 days and 120 days; full mission float lengths were 18 months (540 days). Twelve of the floats were ballasted to drift at 300 dbar and nine were ballasted to drift at 1500 dbar. They were deployed nearly simultaneously (within five a minute window at each station), in sets of three grouped by depth, at four stations (Table 1). The nearly simultaneous nature of the deployments at each station occurred on all subsequent DWDE cruises.

Station	Float ID#	Ballast Pressure (dbar)	Date	Latitude	Longitude
30-day	1070*	1000	19-Jun-2016	22 43.194 N	95 13.032 W
120-day	1119*	1000	19-Jun-2016	22 43.194 N	95 13.032 W
E6	1451, 1464, 1465	300	22-Jun-2016	25 08.988 N	96 25.860 W
E7	1469, 1494, 1450	300	23-Jun-2016	24 54.680 N	95 48.698 W
	1491, 1462, 1463	1500	23-Jun-2016	24 54.701 N	95 48.796 W
E11	1492, 1485, 1466	300	23-Jun-2016	24 40.448 N	95 11.551 W
	1488, 1489, 1490	1500	23-Jun-2016	24 40.455 N	95 11.568 W
E12	1467, 1468, 1484	300	23-Jun-2016	24 26.200 N	94 34.387 W
	1483, 1480, 1481	1500	23-Jun-2016	24 26.220 N	94 34.368 W

TABLE 1 FLOATS DEPLOYED FOR DWDE-1
Float ID numbers 1070 and 1119 were donated to the project by WHOI.

DWDE-2 October 12-22, 2016 R/V Pelican

The second cruise, DWDE-2, occurred October 12-22, 2016 aboard the *R/V Pelican*. Because three of the floats ballasted at 300 dbar from the DWDE-1 cruise surfaced unexpectedly early (see 'Float Performance: Early Risers' section below), it was decided that only the floats ballasted for 1500 dbar would be deployed on this cruise—14 floats ballasted for 300 dbar were thus held back for a subsequent cruise. A total of 10 floats were deployed, nine of which were deployed in sets of three at stations (Figure 6) with mission lengths of 540 days. An additional monitor float, ballasted at 1500 dbar with a mission length of 120 days, was added (Table 2).

Station	Float ID#	Ballast Pressure (dbar)	Date	Latitude	Longitude
120-day	1482	1500	19-Oct-2016	24 30.643 N	92 38.826 W
E7	1455, 1478, 1479	1500	17-Oct-2016	24 54.738 N	95 48.722 W
E11	1454, 1460, 1461	1500	17-Oct-2016	24 40.406 N	95 11.491 W
E12	1456, 1472, 1473	1500	17-Oct-2016	24 26.298 N	94 34.500 W

TABLE 2 FLOATS DEPLOYED FOR DWDE-2

DWDE-3 April 22-May 1, 2017 R/V Pelican

The third cruise, DWDE-3, occurred April 22-May 1, 2017 on board the *R/V Pelican*, successfully deployed thirty-two of the thirty-three floats planned; four monitor floats and 28 full-mission science floats. Float 1451 encountered a vacuum failure and was not deployed. The full-mission science float group consisted of 16 300-dbar floats and 12 1500-dbar floats and were programmed for missions of 540 days. These floats were deployed in groups of four, starting with four 1500-dbar floats and followed by four 300-dbar floats at three stations. An additional group of four 300-dbar floats were deployed at a fourth station which was in shallower water (Figure 6).

In order to check the performance of the four sound sources in the water, two additional stations were added to the cruise plan to deploy four monitor floats. The monitor floats, all ballasted for 1500 dbar, were launched prior to the full mission floats. Two were programmed for two-day missions and two were programmed for 127-day missions (Table 3).

Station	Float ID#	Ballast Pressure (dbar)	Date	Latitude	Longitude
2-day	1467*	1500	24-Apr-2017	26° 26.411 N	92°20.684 W
	1518	1500	24-Apr-2017	26° 02.920 N	92°36.340 W
127-day	1527	1500	28-Apr-2017	25° 03.431 N	94°41.851 W
	1528	1500	28-Apr-2017	25° 03.429 N	94°41.849 W
E 13	1497, 1502, 1503, 1506	300	27-Apr-2017	24° 57.091 N	94°24.231 W
	1516, 1517, 1525, 1526	1500	27-Apr-2017	24° 57.075 N	94°24.229 W
E14	1498, 1499, 1505, 1509	300	28-Apr-2017	25° 11.931 N	94°59.534 W
	1519, 1520, 1523, 1524	1500	28-Apr-2017	25° 11.925 N	94°59.529 W
E15	1500, 1508, 1512, 1513	300	28-Apr-2017	25° 22.019 N	95°29.610 W
	1521, 1522, 1530, 1531	1500	28-Apr-2017	25° 21.958 N	95°29.611 W
E16	1496, 1501, 1504, 1507	300	29-Apr-2017	25° 39.898 N	96°13.880 W

TABLE 3 FLOATS DEPLOYED FOR DWDE-3

This was the second deployment for float ID#1467. It had been found and returned to WHOI, refurbished at Seascan, Inc., and was able to be re-used to monitor the sound source array. It is referred to as float ID#9999.

DWDE-4 November 4-13, 2017 R/V Pelican

The final float deployment cruise intended for the project, DWDE-4, took place November 4-13, 2017 on board the *R/V Pelican*. Feedback from DWDE-3 2-day monitor floats and early risers indicated that the signal from sound source D2 was weakening with time. We were able to recycle a sound source recovered from the earlier Gulf of Mexico project to replace it. The first task of DWDE-4 was to deploy an additional sound source mooring (D5), about 120 kilometers northeast of D2 (Figure 6).

Twenty-four floats were prepared with mission lengths of 365 days to be launched at five stations during this cruise. Four of the ten floats ballasted for 1500 dbar failed the pre-deployment vacuum check and were not launched. All 18 floats ballasted for 300 dbar were successfully launched. The 300-dbar floats were deployed in groups of four at three stations (E6, E9, E12) and in groups of three at two stations (E7, E11). The 1500-dbar floats were deployed in pairs at stations E7, E11, E12 (Table 4).

Station	Float ID#	Ballast Pressure (dbar)	Date	Latitude	Longitude
E06	1474, 1475, 1476, 1477	300	8-Nov-2017	25° 09.053 N	96° 25.898 W
E07	1457, 1458, 1459	300	8-Nov-2017	24° 54.727 N	95° 48.793 W
	1537, 1538	1500	8-Nov-2017	24° 54.719 N	95° 48.793 W
E09	1452, 1453, 1486, 1487	300	8-Nov-2017	24° 47.615 N	95° 30.182 W
E11	1511, 1514, 1515	300	9-Nov-2017	24° 40.479 N	95° 11.559 W
	1533, 1534	1500	9-Nov-2017	24° 40.479 N	95° 11.569 W
E12	1470, 1471, 1493, 1510	300	9-Nov-2017	24° 26.130 N	94° 34.349 W
	1529, 1536	1500	9-Nov-2017	24° 26.224 N	94° 34.416 W

TABLE 4 FLOATS DEPLOYED FOR DWDE-4

DWDE-Extra March 29, 2018 R/V Pelagia

A cruise of opportunity with the Dutch vessel *R/V Pelagia* allowed us to deploy the four floats that failed the pre-deployment tests on DWDE-4. The floats had been shipped back to Seascan, Inc. for inspection and vacuum seal repair. These were scheduled for 300 mission days. The goal was to find a ship working west of 91° W and in water deeper than 1800 m in order to give the floats a good chance of remaining in the western Gulf and passing through the study region where the other floats had been deployed (Table 5). The four floats were successfully deployed on March 29, 2018 (Figure 6).

Station	Float ID#	Ballast Pressure (dbar)	Date	Latitude	Longitude
N/A	1532	1500	29-Mar-2018	26.8795 N	91.3261 W
N/A	1535	1500	29-Mar-2018	26.8812 N	91.3277 W
N/A	1539	1500	29-Mar-2018	26.9447 N	91.3466 W
N/A	1540	1500	29-Mar-2018	26.9433 N	91.3451 W

TABLE 5 FLOATS DEPLOYED FOR DWDE-EXTRA

Sound Source Recovery cruise March 7-14, 2019 R/V Pelican

In March 2019, the crew and science party aboard the *R/V Pelican* recovered all five sound sources deployed during this experiment. There were no issues with the recovery or communication with the sound sources. Once the sound sources were on deck, the internal clock and the ship's clock were recorded at least five times. The internal clock time was subtracted from the ship's clock time to calculate the clock offset for the sound source. A positive offset indicates the sound source clock got slower over time and a negative offset indicates the sound source clock got faster over time. The time drift was applied to the sound source data when tracking the floats. A precise drift is extremely important to the accuracy of the float tracks (Table 6).

Name	Lat	Lon	Depth (m)	Deploy	Recover	Ship's clock – SS clock (MM:SS)	Drift (sec/day)
D1	26.03	-95.08	900	2016 06 17	2019 03 09	2:20	-0.123
D2	23.63	-96.51	900	2016 06 18	2019 03 10	-00:06	0.006
D3	23.14	-93.14	900	2016 06 20	2019 03 12	00:04	-0.004
D4	25.59	-91.99	900	2016 06 16	2019 03 13	-00:05	0.005
D5	24.93	-95.89	1009	2017 11 06	2019 03 11	00:04	-0.005

TABLE 6 SOUND SOURCE INFORMATION

SOUND SOURCE PERFORMANCE

Depth and Locations

The first four sound sources were positioned in a box-shaped configuration: the two western moorings were on the slope at ~2000-m water depth and the two eastern moorings were in the central basin at ~3000-m water depth (Figure 6). This configuration was designed to eliminate shadow zones – regions in which sound is blocked by bathymetry between the float and sound source. The placement of the sources ensured that as each float drifted around the western gulf, it would be able to always receive sound signals from at least three sound sources. When source D3 was moved to the northeast due to issues from Tropical Storm Danielle, the science party on board the *R/V Pelican* checked with the Bower Lab to make sure the new position would still provide maximal sound coverage for the floats. Although the location was ~100-m

deeper, this did not affect sound quality. The sound signal source array *as a whole* provided high-quality signals throughout the float deployment period, as seen in the TOA plots in Appendix J.

Monitor and Early Riser Float Data Feedback

Monitor floats were deployed to provide information on the quality of the individual sound source signals. Two monitors were deployed during DWDE-1: one with a 30-day mission length, and one 120-day mission. Two monitor floats were deployed during DWDE-2: one with a 2-day mission, and one 120-day mission. During DWDE-3, two 2-day and two 127-day monitor floats were deployed (Figure 5, Figure 6).

Initial feedback from the 30-day monitor floats deployed as part of DWDE-1 showed all four sources to be functioning well. Feedback from the DWDE-3 2-day monitor floats and early risers showed the sound sources, as a whole, were working well even though sound source D2 (located in the southwest Gulf) was found to be transmitting a weak signal. An additional sound source (D5) was deployed as part of DWDE-4 to replace D2, and was deployed about 120 kilometers to the northeast (Figure 6). An early riser from DWDE-4 showed that the new sound source was working well.

FLOAT PERFORMANCE

A total of 93 RAFOS floats were deployed as part of the CICESE DWDE experiment, comprising 46 deployed at 300 dbar, 40 deployed at 1500 dbar, and seven monitor floats deployed at either 1000 dbar or 1500 dbar (Table 7). Of the 93 floats deployed, 51 completed a full mission, 33 surfaced before their mission was completed, two did not collect data, and seven never surfaced (Figure 5). The total number of floats successfully tracked for this project was 84. Appendix A includes two tables for each float deployment: a summary of deployment and a list of individual float deployment metadata. In summary, we collected 73 float-years of data.

Mission Type	Number Deployed	Early Riser	Did Not Surface	No Data	Full Mission	Tracked Data
Monitor 2-day	2	0	0	1	1	1
Monitor 30-day	1	0	0	0	1	1
Monitor 120-day	2	1	0	1	0	1
Monitor 127-day	2	0	0	0	2	2
Full Mission 300-dbar	46	32	6	0	8	40
Full Mission 1500-dbar	40	0	1	0	39	39
Totals	**93**	**33**	**7**	**2**	**51**	**84**

TABLE 7 SUMMARY OF FLOAT PERFORMANCE

Early Risers

As stated above, 33 floats surfaced before the end of their scheduled mission, and all but one of these early risers were ballasted for 300 dbar. The first five floats to surface early were from the DWDE-1 group, were found in Florida, Texas, and Mexico and returned to WHOI. After examining these floats, it was discovered that the burn wires were still intact and the floats were still in mission mode when they surfaced. This led to the conclusion that external forces such as trawling, swordfish attack, or shark bite most likely caused the drop weight to release early. Conversations with WHOI biologist Dr. Simon Thorrold led us to conclude that the most likely candidate for these 300-dbar early risers was sharkbite.

As a result of the early risers from DWDE-1, we decided to not deploy the DWDE-2 floats ballasted for 300 dbar in order to make modifications to the float firmware. The firmware was modified to transmit the data if the surface pressure was detected prior to the end of the mission, in case of interference causing the float to drop its weight and rise early. If the surface was detected, but the burn wire was still intact, the float would transmit the data. The one deep float early riser may have been a result of the float scraping the seafloor, stretching and breaking the drop weight monofilaments, as this has occurred in other experiments.

Skipped data during transmission

For unknown reasons, there were issues transmitting some of the SBD data back to the server, resulting in missing SBD messages for 50 of the 85 floats. There was no apparent pattern as to when or why the data transmission problems would arise, although the authors suspect that extreme surface wave height (i.e., storms) interfered with data transmission. Skipped messages occurred in floats ballasted at both 300 dbar and 1500 dbar, monitor floats, full mission floats, and early risers. DWDE-Extra was the only set of floats that did not have transmission errors (Table 8). When missing messages were found, a command file 'Repeat_Data.sbd' was sent through the Iridium network to the float, which prompted the float to re-transmit the entire mission data set. This sometimes resulted in full data return, but not always.

Some of the floats had multiple skips in SBD messages, while others only had one or two skips. Sometimes the Receiver_Data and Drift_Data files had the same skipped messages and the files could easily be concatenated, with gaps filled with NaNs. The Receiver_Data and Drift_Data files are the output files produced from the gathering all SBD message values collected during a float's mission. The Receiver_Data file has

thirteen columns: float time at the start of the listening window, and a TOA value and correlation value for each sound source signal returned. The Drift_Data file has three columns: float time at end of the listening window, pressure, and temperature.

Other times the receiver and drift files would have different missing data. In those cases, the drift files and receiver files were concatenated respectively and time gaps were filled with NaNs. Then the length and times of the drift and receiver files were compared and checked for consistency. Although this was a cumbersome process, the resulting final data does not seem to have been compromised.

Cruise ID	Good	Skips	Total
DWDE-1	8	9	17
DWDE-2	0	9	9
DWDE-3	15	15	30
DWDE-4	9	15	24
DWDE-Extra	4	0	4
Total	**36**	**48**	**84**

TABLE 8 SKIPPED SHORT-BURST DATA PACKETS DURING TRANSMISSION

'Good' indicated that the float returned all short-burst data packets; 'Skips' indicates that a float missed at least one short-burst data packet. The total of 84 reflects the fact that out of 93 floats deployed, seven were no-shows, and two float surfaced but returned no data (84+7+2 = 93).

Data Return

The percent data returned was based on what the float had the ability to do. As an example, data return for the 'early risers' was based on the number of days the float was underwater and was not based on the full mission length that the float was programmed.

DWDE-1 Of the 23 floats deployed during DWDE-1, 13 surfaced after completing their full mission, four surfaced early, and six did not surface; a data return of 56%. This is lower than expected due to the unforeseen 'sharkbite' floats that surfaced early due to a disruption during the mission. Fortunately, the four early risers were found by fisherman who sent the floats back to WHOI, where the data were recovered. There was 100% data return for the 9 floats ballasted at 1500 dbar, which all surfaced at the end of the full mission and transmitted all data. Of the 12 shallow floats, two returned data for the full mission length, four surfaced early and data were recovered for about 1/5 of the mission length, and six floats presumably surfaced early like the other 300-dbar floats, but no transmissions were sent at mission end. The authors suspect these floats were damaged by ship, shore, or other in the long surface drift period.

DWDE-2 All 10 floats deployed during the second seeding were ballasted for 1500 dbar. The nine full mission floats completed the entire mission and transmitted 100% of their data. Even though the one monitor float surfaced after three days and no data was collected, the total data yield for the second seeding was still 98%.

DWDE-3 The data return for DWDE-3 was 63%, which was lower than expected due to an unexpected disruption during the 300-dbar float missions causing the floats to surface before the completion of their missions, as in DWDE-1. Of the 32 floats deployed, 17 completed their entire mission, 15 floats were early risers, one 2-day monitor float completed its mission but transmitted null data, and only one float did not surface. The 15 early rising floats were all ballasted for 300 dbar. The one float that did not surface was ballasted at 1500 dbar. We believe that this float may have hit the seafloor.

DWDE-4 The fourth seeding of floats included 18 floats ballasted at 300 dbar and six floats ballasted at 1500 dbar. All 24 floats were set to be full mission floats, scheduled for 365 days. There were 11 full mission floats and 13 early risers, all of which transmitted the data they had collected. As with the previous deployments, the 1500-dbar floats had the highest success rate with all 1500-dbar floats completing their mission. Only five of the 300-dbar floats completed the full missions, while the remaining 13 were all early risers.

DWDE-Extra The four floats launch on this final cruise were floats that had failed the pre-deployment checks on DWDE-4. These floats were programmed for 300 days and ballasted at 1500 dbar. All four floats completed their 300-day missions and transmitted the data collected. The TOA data recorded for float 1539 were poor quality and the float could not be tracked. The temperature and pressure data collected were good quality and useful.

Cruise ID	Days Completed	Days of Data	Data Return
DWDE-1			
All	6,506	5,540	85%
300-dbar	535	530	99%
1500-dbar	4,860	4,860	100%
DWDE-2			
All	4,980	4,860	98%
1500-dbar	4,980	4,860	98%
DWDE-3			
All	9,152	9,138	99%
300-dbar	2,945	2,944	99%
1500-dbar	6,198	6,194	99%
DWDE-4			
All	5,851	5,834	99%
300-dbar	3,661	3,644	99%
1500-dbar	2,190	2,190	100%
DWDE-Extra			
All	1,200	1,200	100%
1500-dbar	1,200	1,200	100%

TABLE 9 DATA RETURN FOR EACH SEEDING AND EACH BALLAST DEPTH

SOUND SOURCE DRIFT CALCULATIONS

Typically, a sound source clock drifts between a few seconds to 100 seconds (or more in rare cases) over the course of a multi-year deployment. To correct for this offset, for each sound source, we calculated the sound source clock drift and removed it from the sound source TOA signal before tracking. The sound source clock drifts were calculated both from observed offsets measured by the instrument, and by the inferred offsets derived from the TOAs recorded by the floats. Both methods are described below. In practice, we used the inferred drifts when tracking the floats.

Measured Sound Source Clock Drift

First, the measured drift was calculated using the pre-deployment and post-deployment times for sound source clock and ship's clock (GMT). The sound source clocks were checked and recorded on deck just before deployment and were found to be synchronized with GMT. Upon recovery, the sound source clocks were immediately checked again and recorded. Observed drifts were derived by subtracting the sound source clock time at recovery from the ship's clock time at recovery and dividing by the length of time of the deployment (Table 10).

$$Measured\ Drift\ (seconds/day) = \frac{(Ship\ Time_{recover} - Sound\ Source\ Time_{recover})}{Length\ of\ deployment}$$

Inferred Sound Source Clock Drift

The inferred sound source clock drift was calculated using the difference between the expected and observed signal arrival time at the launch and surface of each float's mission. We used only data values where float launch (surface) and first (last) recorded TOA were within 24 hours, and float had launch (surface) satellite-derived position data.

Estimated TOAs at the beginning and end of the float mission were established using the distance between the recorded GPS position of the float and the location of the sound source and dividing by sound speed representative of the mean at the sound channel axis (Figure 4).

$$Estimated\ TOA_{initial} = \frac{(Sound\ Source\ Position - Float\ GPS\ Position_{initial})}{Sound\ Speed}$$

$$Estimated\ TOA_{end} = \frac{(Sound\ Source\ Position - Float\ GPS\ Position_{end})}{Sound\ Speed}$$

The recorded TOAs needed to be adjusted for the pong time. Each sound source has a unique time at which they pong after the float's listening window opens. This allows us to identify which sound source the TOA came from. The true TOA value was found by subtracting the unique pong time from the recorded TOA values (Table 10).

$$True\ TOA_{initial} = RecordedTOA_{initial} - Sound\ Source\ Pong\ Time$$

$$True\ TOA_{end} = RecordedTOA_{end} - Sound\ Source\ Pong\ Time$$

The inferred drift was found by subtracting the Estimated TOA from the True TOA at the beginning and end of the mission and calculating a linear trend.

$$Inferred\ Offset_{initial} = True\ TOA_{initial} - Estimated\ TOA_{initial}$$

$$Inferred\ Offset_{end} = True\ TOA_{end} - Estimated\ TOA_{end}$$

$$Inferred\ Drift_{final} = linear\ regression(Recorded\ Offset\ Times, Observed\ Offsets)$$

In practice, inferred drifts are used in float tracking since the drifts are derived from several points and various instruments. For these data, the initial sound source clock offset (at deployment) used was zero and the inferred sound source drifts calculated above were applied to the final float tracks during processing. Details of the sound source positions, offsets, and drifts in graphical format may be found in Appendix D. Table 10 summarizes the sound source drifts used in final float data processing. We find

no clear reason why the inferred drifts were sometimes different from the measured drifts from a sound source. When tracking, we used the inferred drifts.

Name	Position		Depth (m)	Deploy	Recover	Reference ('Pong') Time (HH MM)	Clock Offset (MM:SS)		Drift (sec/day)
	Lat	Lon		YYYY MM DD			Initial	Final	
D1	26.03	-95.08	900	2016 06 17	2019 03 09	02 02	0	2:20	-0.123
D2	23.63	-96.51	900	2016 06 18	2019 03 10	02 30	0	-00:06	0.006
D3	23.14	-93.14	900	2016 06 20	2019 03 12	02 45	0	00:04	-0.004
D4	25.59	-91.99	900	2016 06 16	2019 03 13	02 15	0	-00:05	0.005
D5	24.93	-95.89	1009	2017 11 06	2019 03 11	03 00	0	00:04	-0.005

TABLE 10 FINAL SOUND SOURCE DRIFTS

FLOAT DATA PROCESSING

Hexadecimal to Decimal Data

When the float surfaced at the end of its mission, the stored data was transmitted, via Iridium cellphone technology, and received as emails with Short Burst Data (SBD) message files attached (one SBD message for each data point. Using the software package 'Python2RFB' developed as part of this project, these messages where imported, converted from hexadecimal to decimal format, and combined into four processed files: Data_Drfit.txt, Data_Reciever.txt. Mission_Engineering.txt, and Surface_Engineering.txt. Examples of each file type are included in Appendix C.

MATLAB was used to create RFB files from the four processed files above. The RFB file contained all data and information needed to track the floats using the ARTOA3 Float Tracking Software: float programming meta data, launch and surface position and times, float offset times, TOAs, correlation coefficients, temperature, pressure, and window times. An example of an RFB file is included in Appendix C.

Tracking

Using the ARTOA3 Float Tracking Software in MATLAB, the RFB and sound source file were loaded, valid pressure and temperature data were selected, and TOA values were assigned to a specific sound source. Once all data had been selected and assigned, the TOAs were corrected for the Doppler shift and difference in transmission times, and interpolated using a variable (usually 10-day) cubic spline fitting routine. Tracking included using a least-squares method if more than two TOAs were selected. A more detailed description of the float tracking method may be found in Wooding et al. (2005).

The majority of the tracks utilized four or five sound sources, with clear and easily distinguishable TOAs: 38 floats used five sound sources, 25 floats used four sound sources, 18 floats used 3 sound sources, and two floats used two sounds sources. As presented earlier, the early rising floats from DWDE-1 (Float ID#s 1450, 1451, 1464, 1466, 1467, 1469) did not turn off when they reached the surface. For these floats, the last tracked position was used as the surface date. See Appendix H for figures of individual trajectories and properties.

Final Calibration and QC

Overall, the quality of sound source signals was excellent in this field program. As a result, the tracking had a high degree of veracity, and minimal quality control was needed. The final calibration of the float data required application of the final estimated sound source drifts. Once completed, each track was checked for accuracy against an ETOPO2 bathymetry data set. If the measured depth (converted from pressure) of the float at a specific X-Y location was greater than the interpolated depth at the same location, then the trajectory data point was flagged as possibly less accurate.

Because the sound source signal data quality was excellent, although some data points were flagged, no trajectory points were edited due to being 'too deep'. This is not to say that all trajectory points were always in water depth greater than the measured depth; this did occur in some regions when the float was close to steep slopes. As this could be the result of inaccuracies in the gridded depth data set, or slight variations in the sound speed field, these trajectory points were left in the data set. These position points were derived from TOAs of good quality, and considered good. Out of eighty-five float trajectories, thirteen contained over-depth points. Plots of only these floats are included in Appendix I.

A visual method quality control was applied to the final temperature, pressure, and velocity data. Any points that visually stood out as 'not good' – for example, a temperature data point that was degrees outside the range of temperatures measured by the float for the mission - was deleted. Any significant data anomalies in a float were noted in the NetCDF global attributes, discussed in the following section.

Final NetCDF file

Once all tracking was completed and the quality of the data had been checked, the final float data was combined into a single file and saved as a continuous ragged array

NetCDF (Eaton, 2019). The NetCDF contains final tracked data for 83 floats. Since the sole objective of the 2-day monitor float (ID#1518) was to check the quality of the sound source signal, the tracked data is not included in the final NetCDF. The dimensions of the file are: Experiment Name (5), Float (83), and Observations (81,559). The NetCDF Global Attributes are listed in Appendix C. Data may be found in the Center for Scientific Research and Higher Education at Ensenada (CICESE) repository at http://smid.cigom.org.

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APPENDIX A: TABLES

This appendix includes two tables for each float deployment: a summary of deployment and a list of individual float deployment metadata. 'Monitor' indicates the float was used to early-report on the quality of the sound source signals. 'Early riser' indicates the float did not stay underwater for its complete mission. 'Full mission' indicates that the float completed the entire programmed mission. 'DNS' indicates 'Did not surface', meaning that the float failed to transmit any data. 'No data' indicates that the float surfaced and transmitted empty data files. Of the 93 floats deployed, 53 completed a full mission, 33 surfaced before their mission was completed, two did not collect data, and seven never surfaced. The total number of floats successfully tracked for this project was 83. Although the tables list the full mission length that the float was programmed for, the percent data returned was based on what the float had the ability to do. As an example, data for the 'early risers' was based on the number of days the float was underwater and were not based on the full mission length that the float was programmed.

TABLE A- 1 DWDE-1 FLOAT SUMMARY

Type	Number Deployed	Early Riser	Did Not Surface (DNS)	Full Mission
Monitor 30-day	1	0	0	1
Monitor 120-day	1	0	0	1
Full Mission 300-dbar	12	4	6	2
Full Mission 1500-dbar	9	0	0	9
Totals	**23**	**4**	**6**	**13**

TABLE A- 2 DWDE-1 FLOAT DETAILS

Float ID	Ballast Depth (m)	Launch Date YYYYMMDD	Surface Date YYYYMMDD	Programmed Mission Length (days)	Actual Mission Length (days)	Notes
1070	1000	20160619	20160719	30	30	Monitor
1119	1000	20160619	20161017	120	120	Monitor
1450	300	20160623	20161001	540	104	Early riser
1451	300	20160622	20161001	540	105	Early riser
1467	300	20160623	20161001	540	98	Early riser
1469	300	20160623	20161001	540	104	Early riser
1462	1500	20160623	20171215	540	540	Full mission
1463	1500	20160623	20171215	540	540	Full mission
1464	300	20160622	20171214	540	14	Full mission
1466	300	20160623	20171215	540	105	Full mission
1480	1500	20160623	20171215	540	540	Full mission
1481	1500	20160623	20171215	540	540	Full mission
1483	1500	20160623	20171215	540	540	Full mission
1488	1500	20160623	20171215	540	540	Full mission
1489	1500	20160623	20171215	540	540	Full mission
1490	1500	20160623	20171215	540	540	Full mission
1491	1500	20160623	20171215	540	540	Full mission
1465	300	20160622	-	-	-	DNS
1468	300	20160623	-	-	-	DNS
1484	300	20160623	-	-	-	DNS
1485	300	20160623	-	-	-	DNS
1492	300	20160623	-	-	-	DNS
1494	300	20160623	-	-	-	DNS

TABLE A- 3 DWDE-2 FLOAT SUMMARY

Type	Number Deployed	Early Riser	Did Not Surface (DNS)	Full Mission
Monitor 120-day	1	1	0	0
Full Mission 1500-dbar	9	0	0	9
Totals	**10**	**1**	**0**	**9**

TABLE A- 4 DWDE-2 FLOAT DETAILS

Float ID	Ballast Depth (m)	Launch Date YYYYMMDD	Surface Date YYYYMMDD	Programmed Mission Length (days)	Actual Mission Length (days)	Notes
1482	1500	20161019	20161022	120	3	Early riser/No data
1454	1500	20161017	20180410	540	540	Full mission
1455	1500	20161017	20180410	540	540	Full mission
1456	1500	20161017	20180410	540	540	Full mission
1460	1500	20161017	20180410	540	540	Full mission
1461	1500	20161017	20180410	540	540	Full mission
1472	1500	20161017	20180410	540	540	Full mission
1473	1500	20161017	20180410	540	540	Full mission
1478	1500	20161017	20180410	540	540	Full mission
1479	1500	20161017	20180410	540	540	Full mission

TABLE A- 5 DWDE-3 FLOAT SUMMARY

Type	Number Deployed	Early Riser	Did Not Surface (DNS)	Full Mission
Monitor 2-day	2	0	0	2
Monitor 127-day	2	0	0	2
Full Mission 300-dbar	16	15	0	1
Full Mission 1500-dbar	12	0	1	11
Totals	**32**	**15**	**1**	**16**

TABLE A- 6 DWDE-3 FLOAT DETAILS

Float ID	Ballast Depth (m)	Launch Date YYYYMMDD	Surface Date YYYYMMDD	Programmed Mission Length (days)	Actual Mission Length (days)	Notes
9999*	1500	20170424	20170426	2	2	Monitor/No data
1518	1500	20170424	20170427	2	2	Monitor float
1527	1500	20170428	20170902	127	127	Monitor float
1528	1500	20170428	20170902	127	127	Monitor float
1496	300	20170429	20180325	540	330	Early riser
1497	300	20170427	20170725	540	88	Early riser
1498	300	20170428	20170627	540	60	Early riser
1499	300	20170428	20170504	540	6	Early riser
1500	300	20170428	20170730	540	93	Early riser
1501	300	20170429	20171011	540	165	Early riser
1502	300	20170427	20171227	540	243	Early riser
1503	300	20170427	20180116	540	259	Early riser
1505	300	20170428	20170626	540	59	Early riser
1506	300	20170427	20170614	540	47	Early riser
1507	300	20170429	20171211	540	224	Early riser
1508	300	20170428	20170528	540	30	Early riser
1509	300	20170428	20180417	540	354	Early riser
1512	300	20170428	20171014	540	169	Early riser
1513	300	20170428	20180131	540	277	Early riser
1504	300	20170429	20181021	540	540	Full mission
1516	1500	20170427	20181020	540	540	Full mission
1517	1500	20170427	20181020	540	540	Full mission
1519	1500	20170428	20181020	540	540	Full mission
1520	1500	20170428	20181020	540	540	Full mission
1521	1500	20170428	20181020	540	540	Full mission
1522	1500	20170428	20181020	540	540	Full mission
1523	1500	20170428	20181020	540	540	Full mission
1525	1500	20170427	20181020	540	540	Full mission
1526	1500	20170427	20181020	540	540	Full mission
1530	1500	20170428	20181020	540	540	Full mission
1531	1500	20170428	20181020	540	540	Full mission
1524	1500	20170428	DNS	-	-	DNS

* Float ID 9999 is the second deployment of float 1467

TABLE A- 7 DWDE-4 FLOAT SUMMARY

Type	Number Deployed	Early Riser	Did Not Surface (DNS)	Full Mission
Full Mission 300-dbar	18	13	0	5
Full Mission 1500-dbar	6	0	0	6
Totals	**24**	**13**	**0**	**11**

TABLE A- 8 DWDE-4 FLOAT DETAILS

Float ID	Ballast Depth (m)	Launch Date YYYYMMDD	Surface Date YYYYMMDD	Programmed Mission Length (days)	Actual Mission Length (days)	Notes
1452	300	20171108	20180215	365	97	Early riser
1453	300	20171108	20180726	365	259	Early riser
1457	300	20171108	20180802	365	267	Early riser
1458	300	20171108	20171123	365	15	Early riser
1459	300	20171108	20180103	365	49	Early riser
1470	300	20171109	20180809	365	269	Early riser
1475	300	20171108	20180120	365	73	Early riser
1477	300	20171108	20180319	365	131	Early riser
1486	300	20171108	20180321	365	132	Early riser
1487	300	20171108	20181025	365	350	Early riser
1493	300	20171109	20171216	365	37	Early riser
1514	300	20171109	20180304	365	115	Early riser
1515	300	20171109	20171205	365	25	Early riser
1471	300	20171109	20181109	365	365	Full mission
1474	300	20171108	20181108	365	365	Full mission
1476	300	20171108	20181109	365	365	Full mission
1510	300	20171109	20181109	365	365	Full mission
1511	300	20171109	20181109	365	365	Full mission
1529	1500	20171109	20181109	365	365	Full mission
1533	1500	20171109	20181109	365	365	Full mission
1534	1500	20171109	20181109	365	365	Full mission
1536	1500	20171109	20181109	365	365	Full mission
1537	1500	20171108	20181108	365	365	Full mission
1538	1500	20171108	20181108	365	365	Full mission

TABLE A- 9 DWDE-EXTRA FLOAT SUMMARY

Type	Number Deployed	Early Riser	Did Not Surface (DNS)	Full Mission
Full Mission 300-dbar	0	0	0	0
Full Mission 1500-dbar	4	0	0	4
Totals	**4**	**0**	**0**	**4**

TABLE A- 10 DWDE-EXTRA FLOAT DETAILS

Float ID	Ballast Depth (m)	Launch Date YYYYMMDD	Surface Date YYYYMMDD	Programmed Mission Length (days)	Actual Mission Length (days)	Notes
1532	1500	20180329	20190123	300	300	Full mission
1535	1500	20180329	20190123	300	300	Full mission
1539	1500	20180329	20190127	300	300	Full mission*
1540	1500	20180329	20190123	300	300	Full mission

* Float ID 1539 only collected pressure and temperature and did not have TOAs

APPENDIX B: FILE OUTPUTS

This appendix includes samples of the decoded engineering and science data from a single float (Mission Engineering, Surface Engineering, Drift Data, Receiver Data). the compiled science engineering input file (RFB), and the output (RFC) file formats are both used in the float tracking software ARTOA. Details on variable definitions and file data structure may be found in Wooding et al. (2005).

Example of Mission Engineering file output:

Mission Engineering message 300234062354330_000014
Float Current State:
Auxilary Bat = 10.2 Volts
CPU Bat = 10.4 Volts
Vacuum = 69.0 %
System Status = 01
State = 1E
Float Time = Day 6025: 19h 30mn 07s

Example of Surface Engineering file output:

Surface message 300234062354330_000009
Surfacing Position:
Lat = 20 Deg 6.3000 Min
Lon = -95 Deg 34.8540 Min
Gps Time = 21h 01mn 40s
Float Time = 21h 02mn 15s
Gps Tries = 08
Pressure = -0068 cBars
Temperature = 25414 mDeg C
Float Current State:
Auxilary Bat = 8.9 Volts
CPU Bat = 9.1 Volts
Vacuum = 71.0 %
System Status = 01
State = 1A
Float Time = Day 6558: 21h 02mn 15s

Example of Drift Data file output:

0520053900, 15791, 04272
0520082700, 15795, 04272
0520111500, 15812, 04267
0520140300, 15810, 04273
0520169100, 15793, 04270
0520197900, 15824, 04266
0520226700, 15816, 04271
0520255500, 15812, 04265
0520284300, 15840, 04267

Example of Receiver Data file output:

0520048800, 182, 00978, 169, 04057, 151, 09773, 120, 06456, 050, 12213, 047, 03406
0520077600, 200, 00981, 199, 09774, 142, 06453, 140, 04057, 052, 04636, 050, 04970
0520106400, 217, 04060, 180, 00985, 167, 06449, 099, 09775, 055, 07028, 051, 09373
0520135200, 184, 00987, 173, 04062, 150, 09773, 130, 06447, 052, 08622, 050, 02620
0520164000, 223, 09774, 183, 00989, 173, 04065, 061, 10934, 052, 04517, 052, 06445
0520192800, 204, 00992, 174, 04065, 129, 09773, 116, 06442, 051, 03616, 050, 06227
0520221600, 170, 00994, 165, 09773, 154, 04067, 055, 10937, 048, 03005, 048, 07567
0520250400, 166, 00995, 150, 09774, 136, 04067, 066, 06439, 050, 00678, 047, 06811
0520279200, 193, 00996, 176, 09772, 160, 06437, 146, 04068, 053, 10938, 052, 03806

Example of RFB file:

```
rfb1070.rfb
-floatname              RF1070
-type                   WHOI, SEASCAN iridium
-projectname            CICESE-DWDE
-IMEI                   300234010582230
-pttrep                 45.0
-launchpos              22.7199  -95.2172
-launchtime             2016  06  19  01  09
-recoverpos             22.42  -96.0387
-recovertime            2016  07  19  21  20
-offset                 2016  06  19  01  09 0
-offset                 2016  07  19  21  20 0
-cycle                  1  22.7199  -95.2172  2016  6  20  2  00   22.42  -96.0387  2016  7  19  18  00
-progdepth              1000
-progtemp               4.5
-phasespercycle         90
-schedule               8
-phasereftime           00 00
-windowsperphase        1
-toaperwindow           6
-toaperphase            6
-correlationrange       0 255
-windowrange            0 1
-windowstart            120
-windowlength           90
-tempequation           temp
-tempcoeff              1
-presequation           pres
-prescoeff              1
-signal_length          0
-comment
-edited_by              Heather Furey
-edited_on              10-Oct-2019
-comment                Modify offset line
-variables              15
[VARIABLE_LIST]
-line_number            1
-time_of_arrival        3 5 7 9 11 13
-correlation_height     2 4 6 8 10 12
-pressure               15
-temperature            14
-pres_counts            15
-temp_counts            14
[DATA]
   1  181 1213.35   95 1913.83   87 3314.80   59  370.80   54 2829.57   49 3561.72   5.347   991.7
   2  175 1913.52  170 1213.96   52  765.93   47  917.84   46 2575.88   46 3998.99   5.361   995.2
   3  198 1214.88  188 1912.29   79  370.80   60 3316.65   45  800.68   45 4236.38   5.325   993.2
   4  181 1209.04  146 1906.14  120 2846.48   93  364.64   49  865.56   48 2106.63   5.345   994.9
   5  193 1906.14  190 2846.17  184 1209.04   58  896.93   52  364.64   50 3310.49   5.355   995.9
   6  203  365.26  188 1905.84  181 2846.78  177 1209.96  140 3312.03   52  683.83   5.336   995.1
   7  204 2851.70  191 1904.91  187 1211.19  174  365.26   96 3313.57   50 1139.85   5.362   999.4
```

Example of RFC file:

```
** Float: RF1070
** variables : InterpFlag LineNum RafosDay  Temp  Pres  Lat  Lon  U    V    W
** Units    : #        #     #       degC  dbar  deg  deg  cm/s  cm/s  mm/s
** Dummies   : NA       NA     NA      -9.99 -999  999  999   999   999   999
** Cycle: 1
** Launch position (Cycle Start position): 22.72    -95.217
** Surface position (Cycle End position) : 22.42    -96.039
** Cycle Start time           : 2016    6   20    2    0    0  (RAFOS day 17560.0833)
** Launch time               : 2016    6   19    1    9    0  (RAFOS day 17559)
** Cycle End time             : 2016    7   19   18    0    0  (RAFOS day 17589.75)
** First surface Position time  : 2016    7   19   21   20    0  (RAFOS day 17589)
** Float clock offset (init/final)  : 0 / 0 seconds
** -------
** Tracking method: Least Square
** Interpolation method: Spline
** Interpolation step size: 8 hours
** Interpolation gap size: 10
** Doppler correction: yes
** -------
** Sound source combinations: (rafos day, sound sources, reference position, sound speed)
**    17561.08 to 17589.75: D1 D4 D2 D3    22.7199    -95.2172   1.4878     1.4878     1.4878     1.4878     1.4878
** -------
** Additional Float clock offsets, seconds (beginning, end): 0   0
** -------
 *   |  ----------
999   1 17560.08  5.347  991.7   999.000  999.000   999.00  999.00  999.00
999   2 17560.42  5.361  995.2   999.000  999.000   999.00  999.00  999.00
999   3 17560.75  5.325  993.2   999.000  999.000   999.00  999.00  999.00
 0   4 17561.08  5.345  994.9    22.750  -95.266     0.52    0.91   -0.01
 0   5 17561.42  5.355  995.9    22.750  -95.264     1.81   -1.46    0.02
 0   6 17561.75  5.336  995.1    22.742  -95.270    -11.28   -3.70   -0.09
 0   7 17562.08  5.362  999.4    22.738  -95.317    -13.51    2.69   -0.03
 0   8 17562.42  5.328  998.1    22.754  -95.326     5.09    6.03    0.04
 0   9 17562.75  5.324  995.1    22.755  -95.312    -1.53   -7.73   -0.09
 0  10 17563.08  5.371  999.0    22.731  -95.338    -12.23   -1.94    0.04
 0  11 17563.42  5.333  997.1    22.748  -95.361    -1.53    7.70   -0.07
 0  12 17563.75  5.336  996.7    22.752  -95.351     4.49   -3.90   -0.10
 0  13 17564.08  5.349  999.1    22.737  -95.352    -7.09   -5.60    0.15
 0  14 17564.42  5.385 1001.6    22.728  -95.384    -10.84   -1.12   -0.04
```

APPENDIX C: GLOBAL ATTRIBUTE VARIABLES

This appendix contains a list of the Global Attributes, Dimensions, and Variables for the final NetCDF data file for the DWDE RAFOS float data set. The data set is stored and registered at CICESE and is available upon request.

Global Attributes Discover and Identification	
Site Code	Gulf of Mexico
Platform Code	float
Data Mode	D (delayed)
Title	RAFOSfloatsDWDE-CIGoM
Summary	Conjunto de datos recopilados por los derivadores subsuperficiales del experimento de dispersión en aguas profundas, 2016-2019. Estos datos ya han sido procesados y tienen control de calidad final. La información incluye la información de la trayectoria y los datos medidos a lo largo de la trayectoria de cada derivador. Se hicieron cuatro lanzamientos (experimentos), en los que se lanzaron derivadores preparados para fluir con las corrientes marinas a 300 dbar y 1500 dbar.
	Data set compiled by the subsurface floats of the Deep Water Dispersion Experiment, 2016-2019. These data have already been processed and have final quality control. The information includes the trajectory and the data measured along the path of each float. Four deployments (experiments) were made, in which floats were ballasted to flow with sea currents at 300 dbar and 1500 dbar.
Experiment	Experimento de dispersion en aguas profundas (Deep Water Dispersion Experiment, DWDE)
Project	Implementacion de redes de observacion oceanograficas (fisicas geoquimicas, ecologicas) para la generacion de escenarios ante posibles contingencias relacionadas a la exploracion y produccion de hidrocarburos en aguas profundas del Golfo de Mexico Consorcio de Investigacion del Golfo de Mexico (CIGoM)
Naming Authority	cigom.org
ID	DWDE_rafos
Source	Float
Principal Investigator	Paula Perez Brunius
Principal Investigator Email	brunius@cicese.mx
Principal Investigator URL	https://usuario.cicese.mx/~brunius/
Institution	Centro de Investigación Científica y de Educación Superior de Ensenada
Comment	'Floats [1450 1451 1459 1464 1466 1467 1469 1501] surfaced early (possibly due to shark bite). Used last tracked position and first surface time for tracking these early riser floats. Float_1456 first recorded data in drift/receiver file 06-Dec-2016 10:00, 23.3210 -93.6470. Float_1461 first recorded data in receiver file 08-Nov-2016 10:00, 25.2890 -94.7560 and first recorded data in drift file 18-Oct-2016 2:00; drift data skips at beginning of record. Float_1466 had no surface engineering data, last recorded data 19-Sep-2016, 22.9470 -94.4740. Float_1470 receiver data ends 05-Aug-2018 10:00, used last tracked position. Float_1472 first recorded drift data 18-Oct-2016 2:00 and first recorded receiver data 08-Nov-2016 2:00, 24.1520 -94.5450. Float_1473 first data in drift/receiver 01-Nov-2017 2:00, 24.3700 -94.4280. Float_1475 first data in drift/receiver 09-Nov-2017 2:00, 25.3120 -96.3050. Float_1514 first data in drift/receiver 10-Nov-2017 2:00, 24.6630 -95.0670. Float_1515 first data in drift/receiver 10-Nov-2017 2:00, 24.6680 -95.0590. Float_1539 only pressure and temperature data were collected; no TOA data.'

Global Attributes Geo-Spatial-Temporal	
Area	Gulf of Mexico
Geospatial Latitude Minimum	17
Geospatial Latitude Maximum	29
Geospatial Latitude Units	Degree North
Geospatial Longitude Minimum	-99
Geospatial Longitude Maximum	-87
Geospatial Longitude Units	Degree East
Geospatial Vertical Minimum	148
Geospatial Vertical Maximum	1640
Geospatial Vertical Positive	Down
Geospatial Vertical Units	meter
Time Coverage Start	2016-06-23T02:00:00Z
Time Coverage End	2019-01-23T18:00:00Z
Time Coverage Duration	P944D16H
Time Coverage Resolution	PT8H

Global Attributes Conventions Used	
Instrument	RAFOS
CDM Data Type	Trajectory
Feature Type	Trajectory
Data Type	Trajectory Data
Format Version	1.3
Conventions	CF-1.6, ACDD-1.3
Standard Name Vocabulary	CF Standard Name Table

Global Attributes Provenance	
Date Created	2019-09-20T17:59:21Z
Date Modified	2019-09-20T17:59:21Z
History	Delayed time processed quality controlled at Woods Hole Oceanographic Institution
Processing Level	Data QA/QC
Creator Type	Group
Contributor Name	Heather Furey, Andrée Ramsey, Amy Bower, Paula Pérez Brunius
Contributor Email	hfurey@whoi.edu, aramsey@whoi.edu, abower@whoi.edu, brunius@cicese.mx
Contributor Institution	Woods Hole Oceanographic Institution, Woods Hole Oceanographic Institution, Woods Hole Oceanographic Institution, Centro de Investigación Científica y de Educación Superior de Ensenada

Global Attributes Publication Information	
Publisher Name	Sistema de Manejo Integral de Datos CIGOM
Publisher Email	smid@cigom.org
Publisher URL	http://smid.cigom.org
Acknowledgement	Esta investigacion ha sido financiada por el Fondo Sectorial CONACYT-SENER-Hidrocarburos, proyecto 201441. Esta es una contribucion del Consorcio de Investigacion del Golfo de Mexico (CIGoM).Preparación de los flotadores, adquisición de datos y procesamiento final realizado por RAFOS Float Group en la Institución Oceanográfica Woods Hole (https://www.whoi.edu/science/PO/rafos/background.htm).
	Research funded by the National Council of Science and Technology of Mexico - Mexican Ministry of Energy - Hydrocarbon Trust, project 201441. This is a contribution of the Gulf of Mexico Research Consortium (CIGoM). Float preparation, data acquisition, and final processing performed by the RAFOS Float Group at Woods Hole Oceanographic Institution (https://www.whoi.edu/science/PO/rafos/background.html)
Keywords	RAFOS, trajectory, Gulf of Mexico, RAFOS, Deep Water Dispersion Experiment, ocean circulation

DATA
Dimensions

Dimension Name	Dimension Size
ExpName	5
Float	83
Obs	81559

DATA
Variables

Name	Size	Data Type	Attribute Name	Attribute Value
ExpName	ExpName, float	char	long_name	= Experiment ID
float	float	int32	long_name	= Float Serial Number
			cf_role	= Trajectory ID
			comment	= Floats [1450 1451 1459 1464 1466 1467 1469 1501] surfaced early (possibly due to shark bite). Used last tracked position and first surface time for tracking these early riser floats. Float_1456 first recorded data in drift/receiver file 06-Dec-2016 10:00, 23.3210 -93.6470. Float_1461 first recorded data in receiver file 08-Nov-2016 10:00, 25.2890 -94.7560 and first recorded data in drift file 18-Oct-2016 2:00; drift data skips at beginning of record. Float_1466 had no surface engineering data, last recorded data 19-Sep-2016, 22.9470 -94.4740. Float_1470 receiver data ends 05-Aug-2018 10:00, used last tracked position. Float_1472 first recorded drift data 18-Oct-2016 2:00 and first recorded receiver data 08-Nov-2016 2:00, 24.1520 -94.5450. Float_1473 first data in drift/receiver 01-Nov-2017 2:00, 24.3700 -94.4280. Float_1475 first data in drift/receiver 09-Nov-2017 2:00, 25.3120 -96.3050. Float_1514 first data in drift/receiver 10-Nov-2017 2:00, 24.6630 -95.0670. Float_1515 first data in drift/receiver 10-Nov-2017 2:00, 24.6680 -95.0590. Float_1539 only pressure and temperature data were collected; no TOA data.

DATA
Variables continued

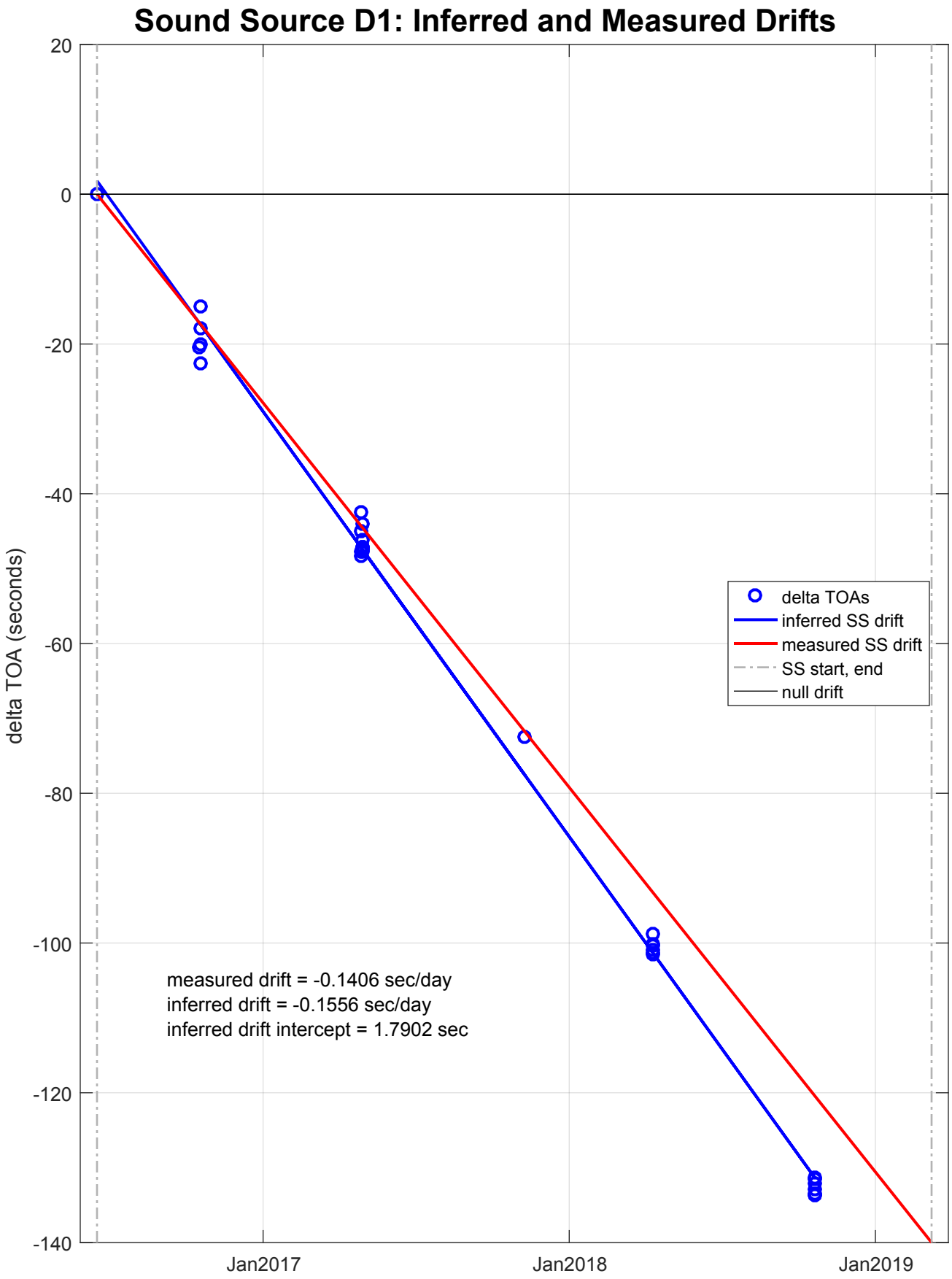
Name	Size	Data Type	Attribute Name	Attribute Value
row_size	float	int32	long_name	= Number of observations for each trajectory
			Sample_dimensions	= obs
ballast	float	int32	standard_name	= ballasting_depth
			long_name	= ballasting_depth
			units	= meter
			reference	= sea_level
			_FillValue	= NaN
LAT_Launch	float	single	standard_name	= latitude
			long_name	= latitude of launch position
			units	= degrees_north
			_FillValue	= NaN
LON_Launch	float	single	standard_name	= longitude
			long_name	= longitude of launch position
			units	= degrees_east
			_FillValue	= NaN
LAT_Surface	float	single	standard_name	= latitude
			long_name	= latitude of surface position
			units	= degrees_north
			_FillValue	= NaN
LON_Surface	float	single	standard_name	= longitude
			long_name	= longitude of surface position
			units	= degrees_east
			_FillValue	= NaN
TIME	obs	double	standard_name	= time
			long_name	= time of observations
			units	= seconds since 1900-01-01 00:00:00
			axis	= T
			calendar	= standard
LAT	obs	double	standard_name	= latitude
			long_name	= latitude of observation
			units	= degrees_north
			axis	= Y
			_FillValue	= NaN
LON	obs	double	standard_name	= longitude
			long_name	= longitude of observation
			units	= degrees_east
			axis	= X
			_FillValue	= NaN

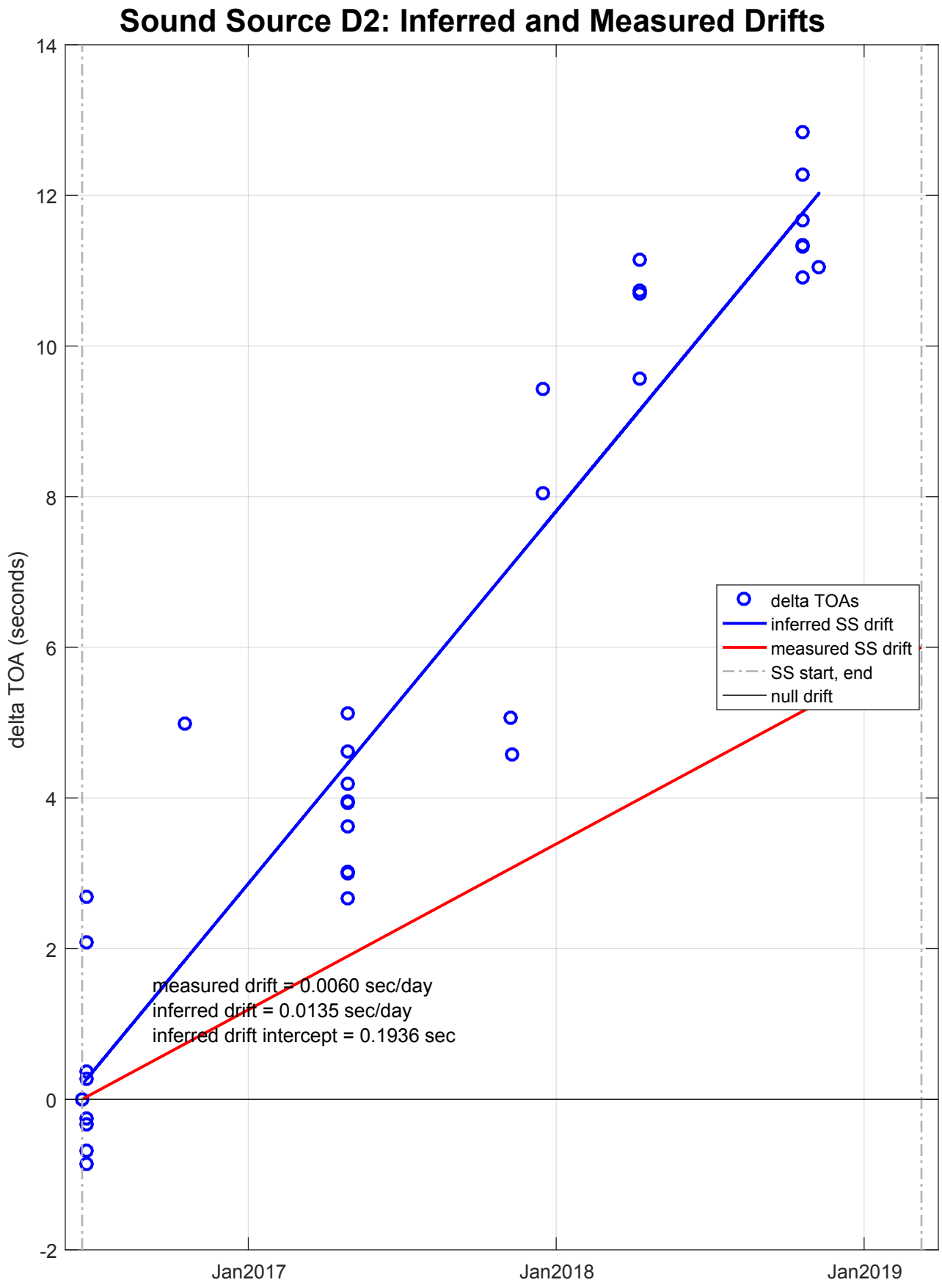
DATA
Variables continued

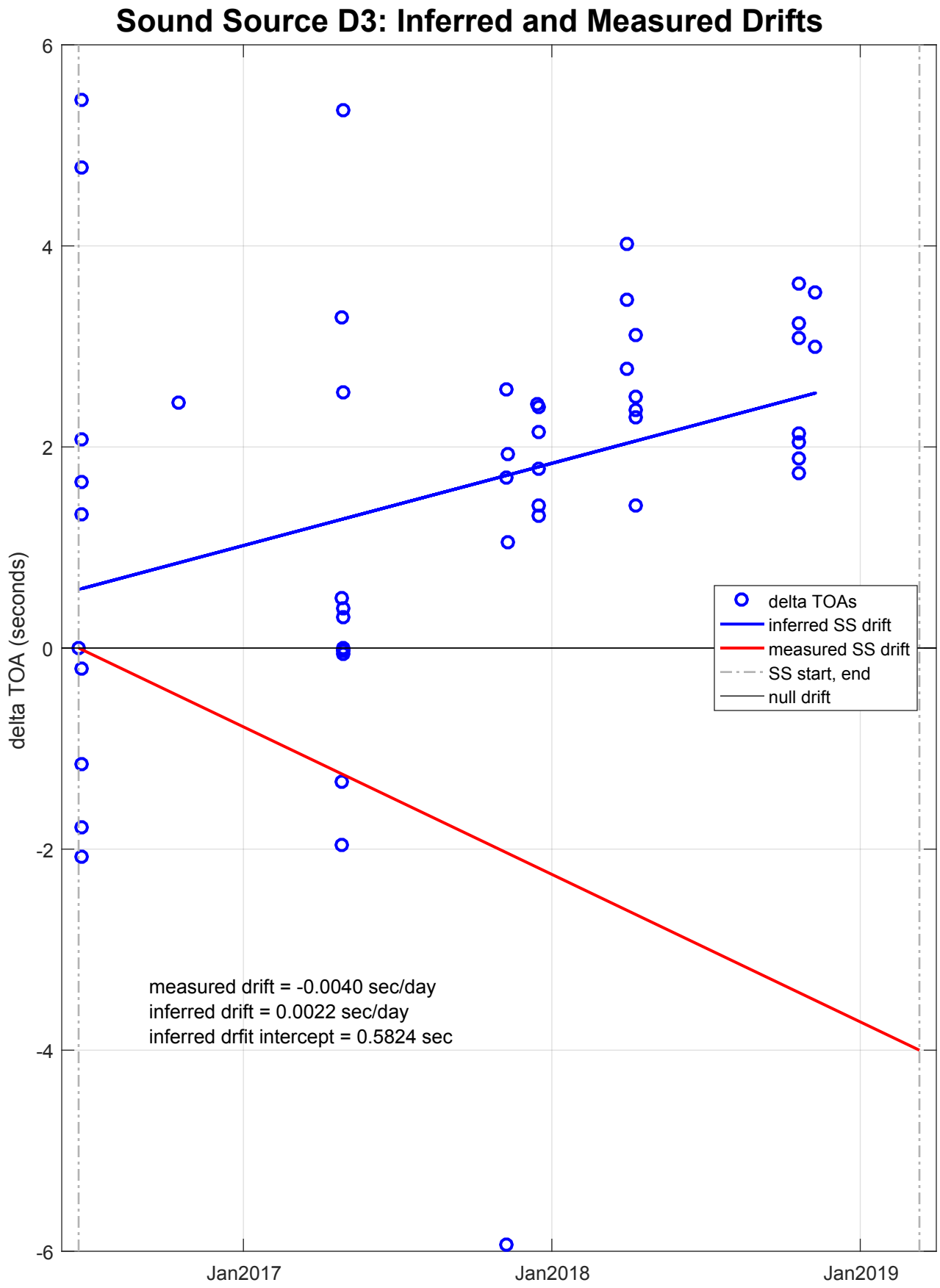
Name	Size	Data Type	Attribute Name	Attribute Value
PRES	obs	double	standard_name units _FillValue processing_level	= sea_water_pressure = decibar = NaN = Data manually reviewed
TEMP	obs	double	standard_name units _FillValue Processin_level	= sea_water_temperature = degree_Celcius = NaN = Data manually reviewed
U	obs	double	standard_name long_name units _FillValue processing_level	= eastward_sea_water_velocity = current east component = meter/second = NaN = Data manually reviewed
V	obs	double	standard_name long_name units _FillValue processing_level	= northward_sea_water_velocity = current north component = meter/second = NaN = Data manually reviewed
Flag	obs	int8	long_name _FillValue valid_range flag_values flag_meaning	= interpolation flag = NaN = 0, 9 = 0, 1, 2, 3, 4, 5, 9 = no TOA times series used in tracked point was interpolated; one TOA point was interpolated; two TOA points used in the least squares algorithm were interpolated; three TOA points used in the least squares algorithm were interpolated; four TOA points used in the least squares algorithm were interpolated; five TOA points used in the least squares algorithm were interpolated; no_data

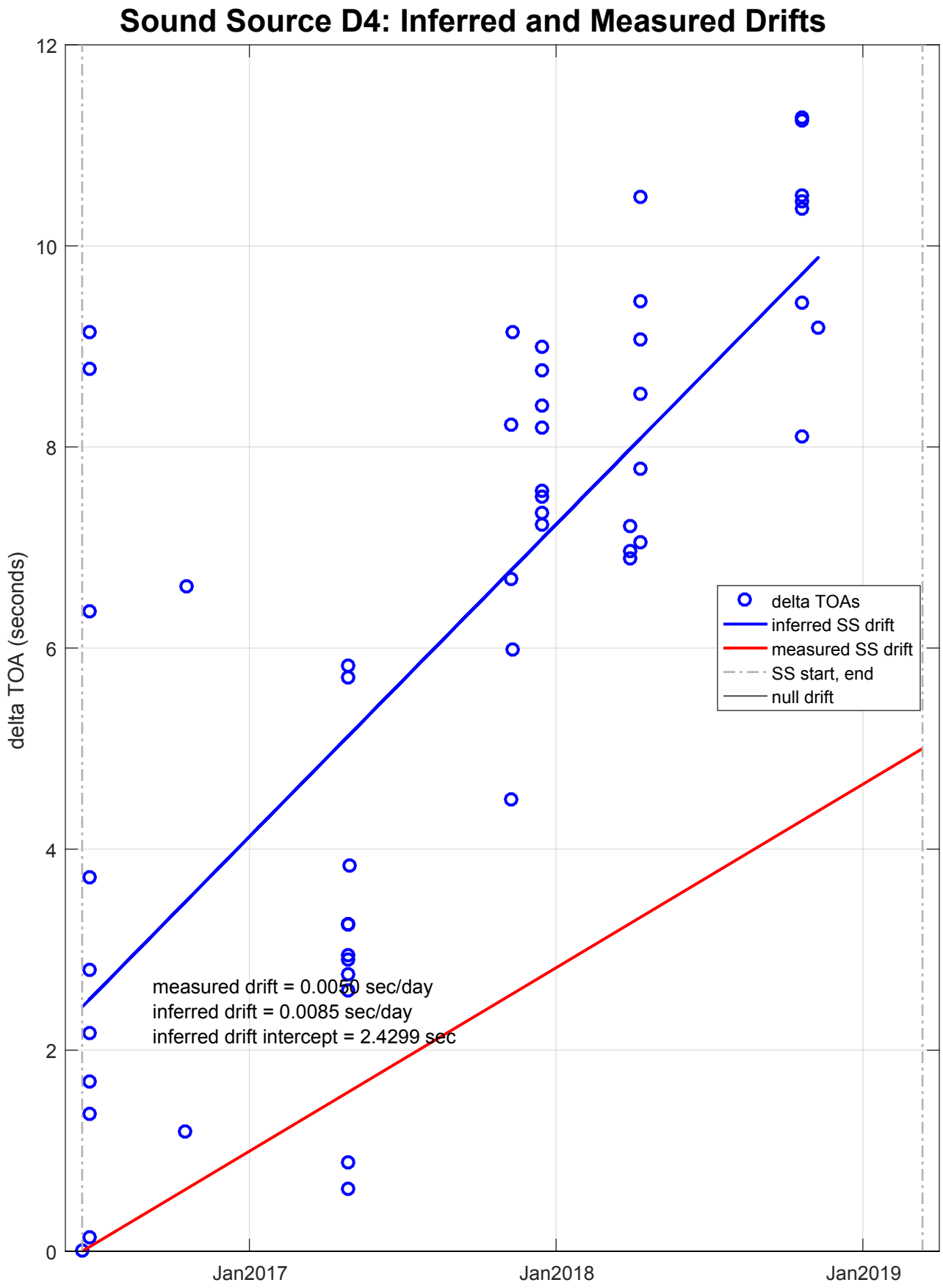
APPENDIX D: SOUND SOURCE DRIFT ESTIMATES

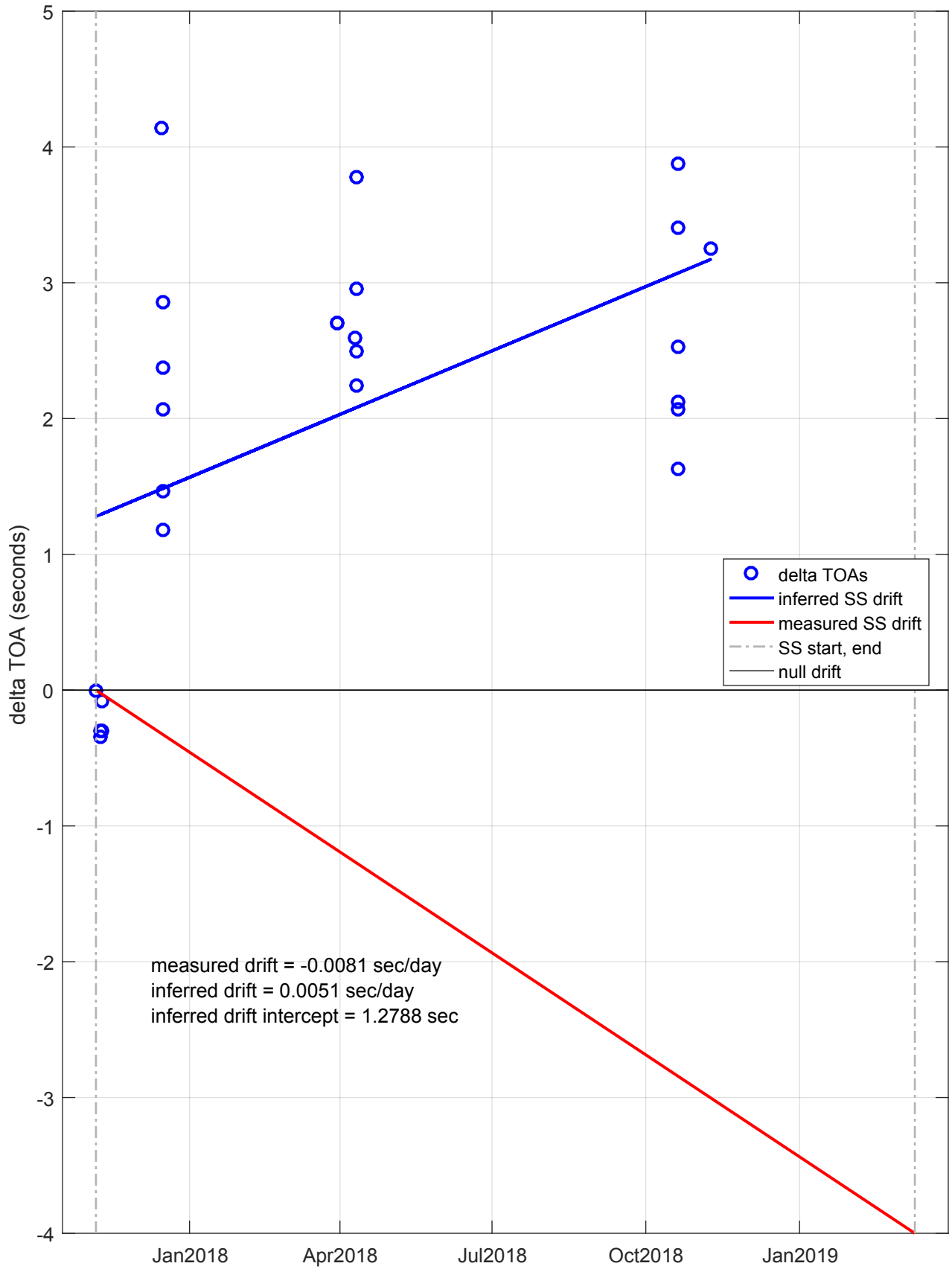
This appendix contains plots of inferred (i.e., float-observed) and measured drifts for each sound source clock used in tracking the CICESE RAFOS float data. The difference between observed minus expected time-of-arrival (TOA) data points pulled from float observations are plotted as blue circles. A first order (linear) fit to the difference data points is the inferred drift (blue line). The measured drift (red line), derived from clock checks of the sound source, is plotted for comparison.


Sound Source D1: Inferred and Measured Drifts
delta TOA (seconds)
20
0
-20
-40
-60
-80
-100
-120
-140
Jan2017
Jan2018
Jan2019
delta TOAs
inferred SS drift
measured SS drift
SS start, end
null drift
measured drift = -0.1406 sec/day
inferred drift = -0.1556 sec/day
inferred drift intercept = 1.7902 sec


Sound Source D2: Inferred and Measured Drifts
delta TOA (seconds)
14
12
10
8
6
4
2
0
-2
Jan2017
Jan2018
Jan2019
delta TOAs
inferred SS drift
measured SS drift
SS start, end
null drift
measured drift = 0.0060 sec/day
inferred drift = 0.0135 sec/day
inferred drift intercept = 0.1936 sec

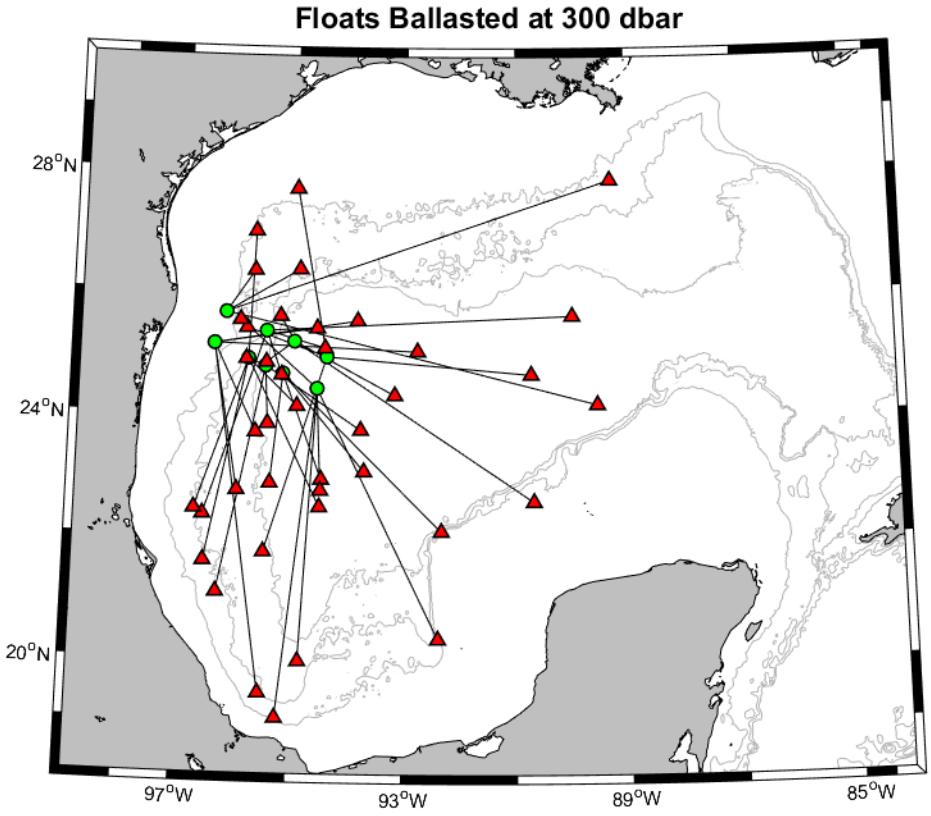

Sound Source D3: Inferred and Measured Drifts
delta TOA (seconds)
6
4
2
0
-2
-4
-6
Jan2017
Jan2018
Jan2019
delta TOAs
inferred SS drift
measured SS drift
SS start, end
null drift
measured drift = -0.0040 sec/day
inferred drift = 0.0022 sec/day
inferred drfit intercept = 0.5824 sec

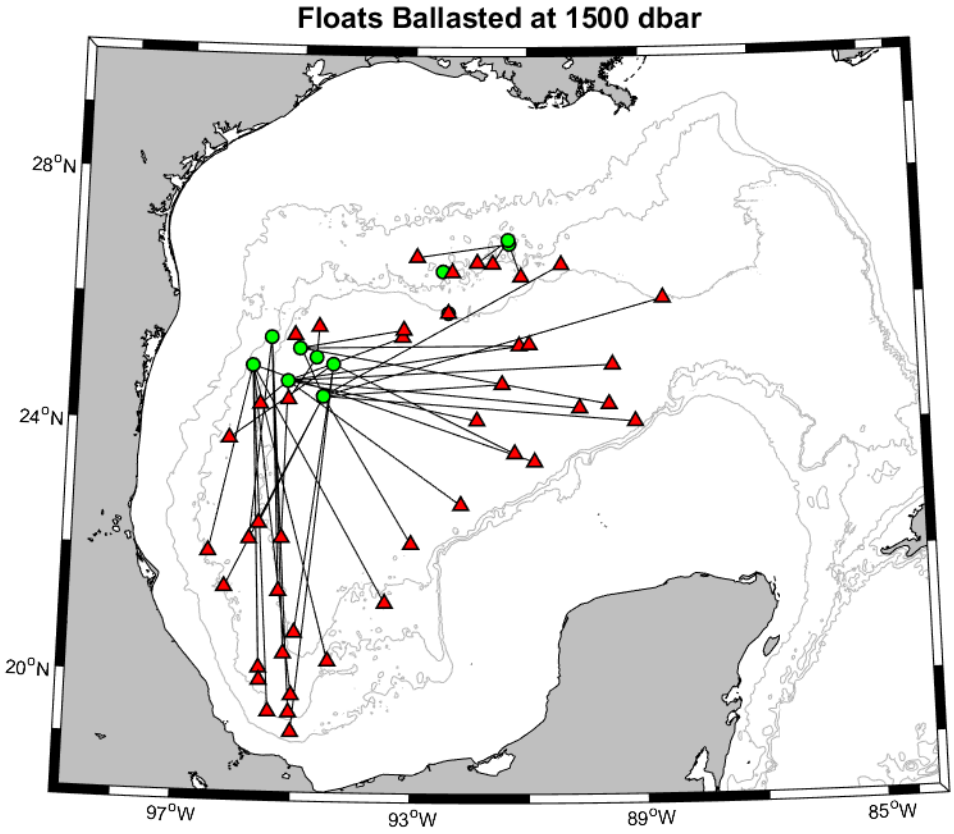

Sound Source D4: Inferred and Measured Drifts
delta TOA (seconds)
12
10
8
6
4
2
0
Jan2017
Jan2018
Jan2019
delta TOAs
inferred SS drift
measured SS drift
SS start, end
null drift
measured drift = 0.0050 sec/day
inferred drift = 0.0085 sec/day
inferred drift intercept = 2.4299 sec

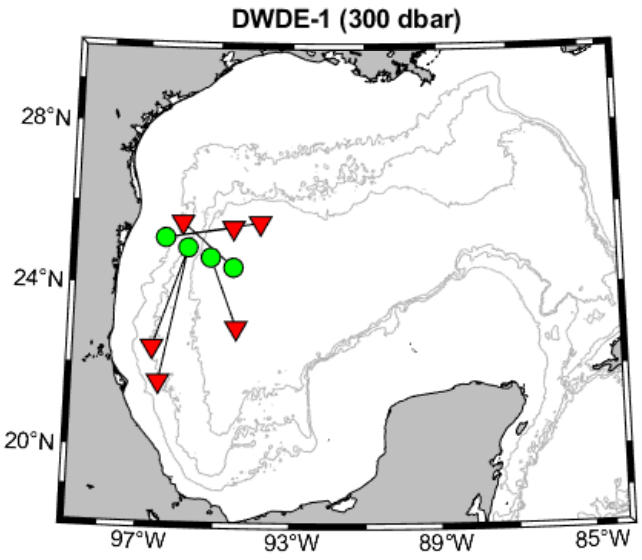

Sound Source D5: Inferred and Measured Drifts
delta TOA (seconds)
5
4
3
2
1
0
-1
-2
-3
-4
Jan2018
Apr2018
Jul2018
Oct2018
Jan2019
delta TOAs
inferred SS drift
measured SS drift
SS start, end
null drift
measured drift = -0.0081 sec/day
inferred drift = 0.0051 sec/day
inferred drift intercept = 1.2788 sec

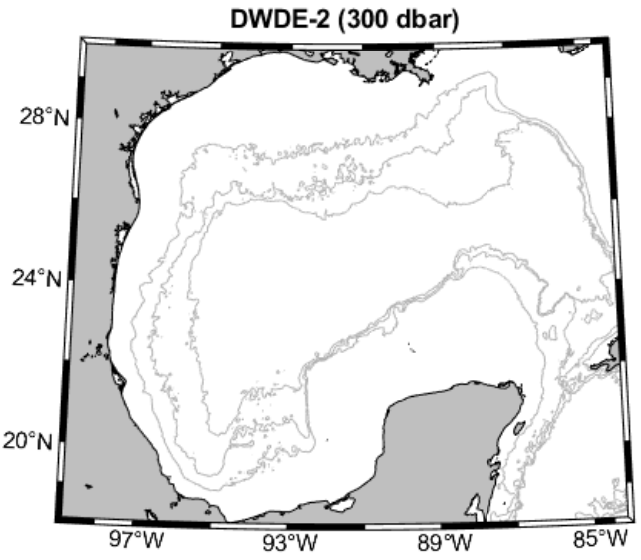
APPENDIX E: FLOAT DISPLACEMENTS

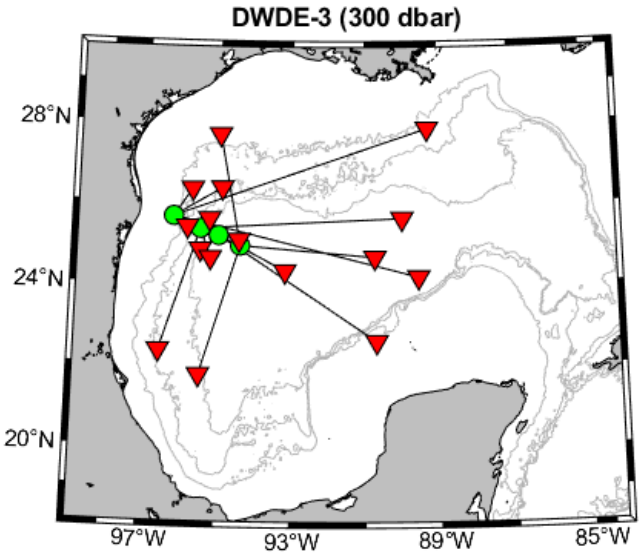
This appendix includes displacement diagrams for all floats, and each seeding of floats individually. A circle indicates launch location, triangle indicates surface locations, and a black line connects the two. Floats are separated into 300-dbar and 1500-dbar groupings. Note that not all mission lengths are the same.

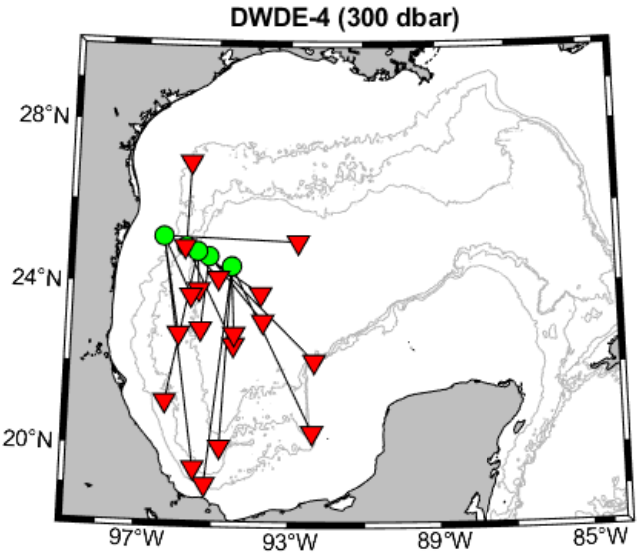

Floats Ballasted at 300 dbar
28°N
24°N
20°N
97°W
93°W
89°W
85°W

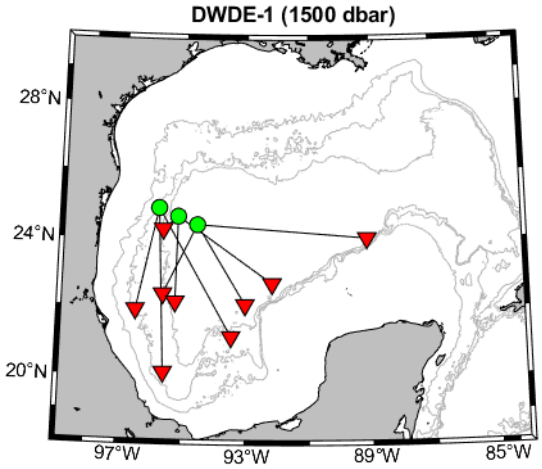

Floats Ballasted at 1500 dbar
28°N
24°N
20°N
97°W
93°W
89°W
85°W

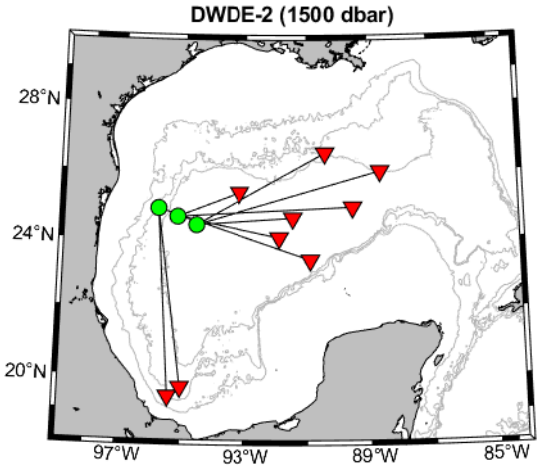

DWDE-1 (300 dbar)
28°N
24°N
20°N
97°W
93°W
89°W
85°W

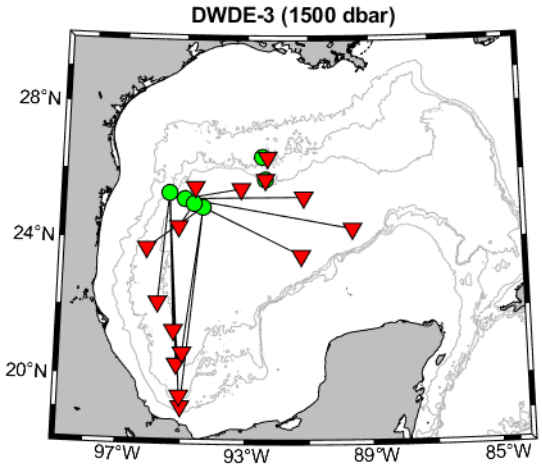

DWDE-2 (300 dbar)
28°N
24°N
20°N
97°W
93°W
89°W
85°W

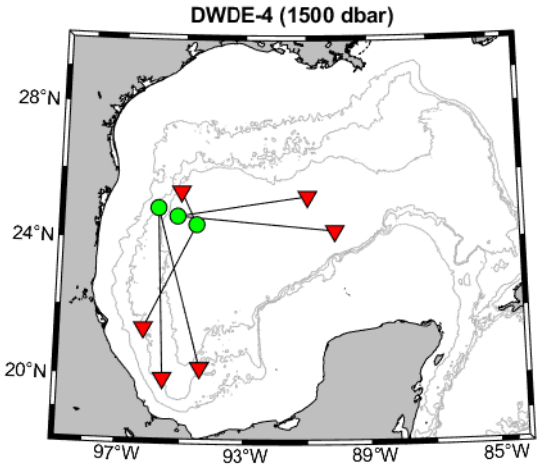

DWDE-3 (300 dbar)
28°N
24°N
20°N
97°W
93°W
89°W
85°W

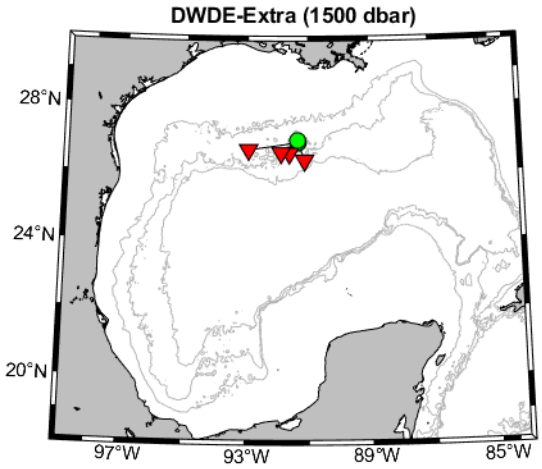

DWDE-4 (300 dbar)
28°N
24°N
20°N
97°W
93°W
89°W
85°W


DWDE-1 (1500 dbar)
28°N
24°N
20°N
97°W
93°W
89°W
85°W


DWDE-2 (1500 dbar)
28°N
24°N
20°N
97°W
93°W
89°W
85°W

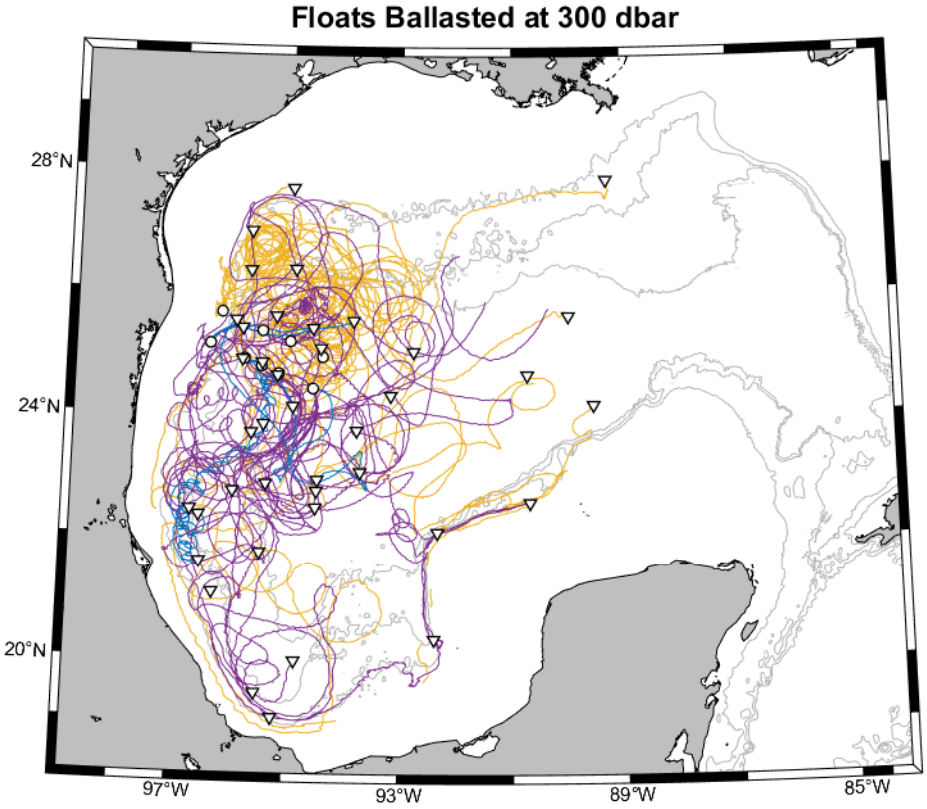

DWDE-3 (1500 dbar)
28°N
24°N
20°N
97°W
93°W
89°W
85°W

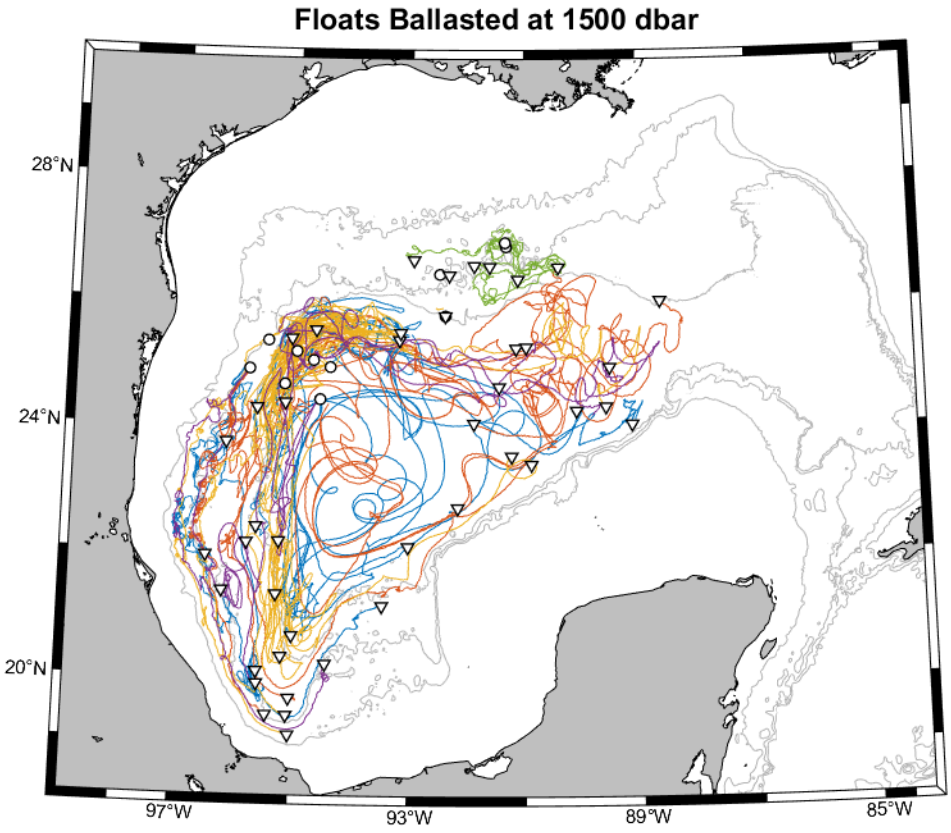

DWDE-4 (1500 dbar)
28°N
24°N
20°N
97°W
93°W
89°W
85°W

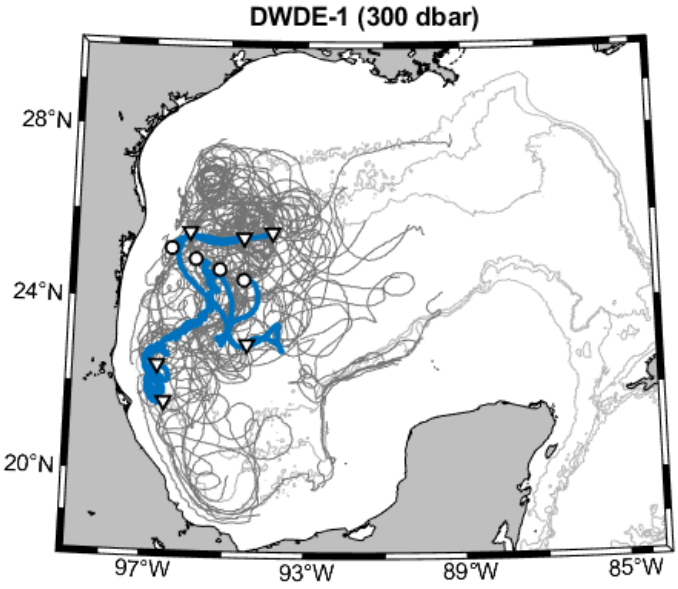

DWDE-Extra (1500 dbar)
28°N
24°N
20°N
97°W
93°W
89°W
85°W

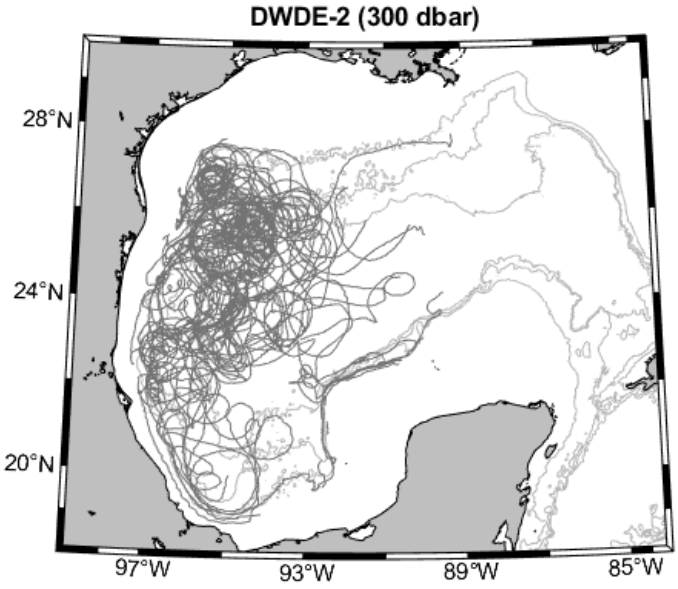
APPENDIX F: TRAJECTORY COMPOSITES

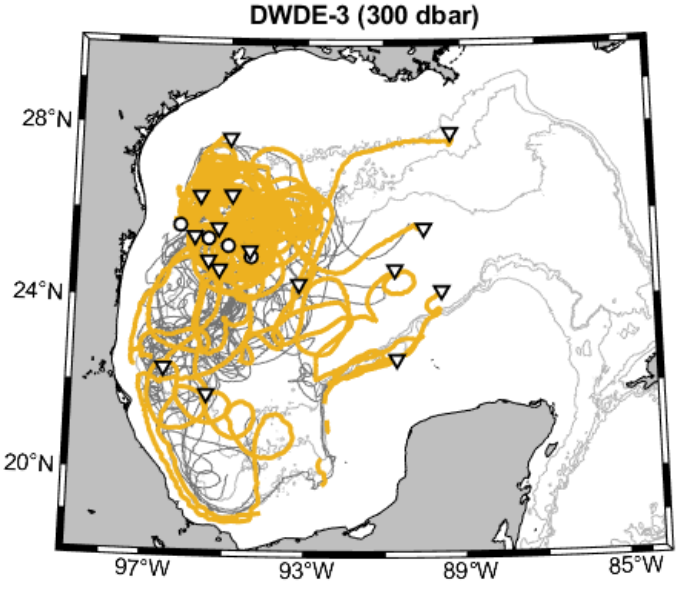
This appendix includes groups of float trajectories: all 300- and 1500-dbar floats, and then each deployment of 300- and 1500-dbar floats. Each seeding is drawn as a different color: DWDE-1 (blue), DWDE-2 (orange), DWDE-3 (yellow), DWDE-4 (purple), DWDE-Extra (green). The deployment location is marked as a circle, surface location as a triangle. Bathymetry is drawn every 1000 –m. On individual deployment plots, all floats are rendered in light gray beneath the single seeding set of floats.

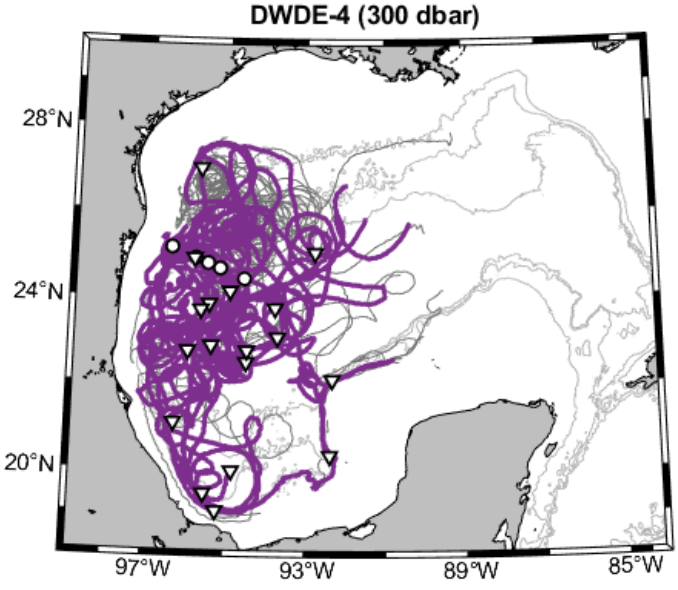

Floats Ballasted at 300 dbar
28°N
24°N
20°N
97°W
93°W
89°W
85°W

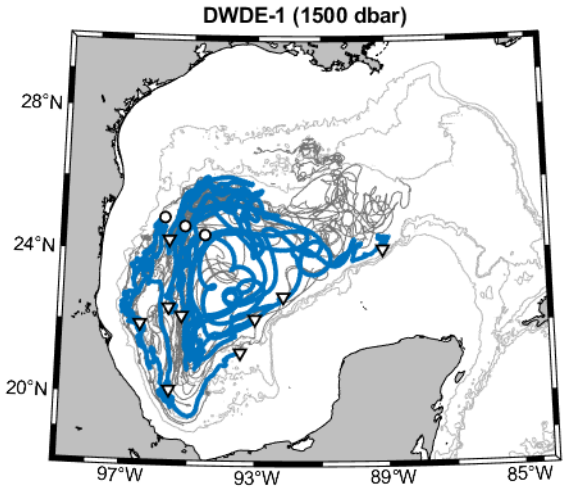

Floats Ballasted at 1500 dbar
28°N
24°N
20°N
97°W
93°W
89°W
85°W

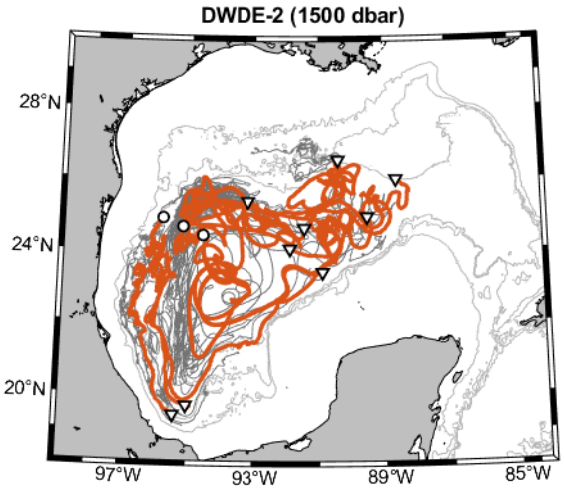

DWDE-1 (300 dbar)
28°N
24°N
20°N
97°W
93°W
89°W
85°W

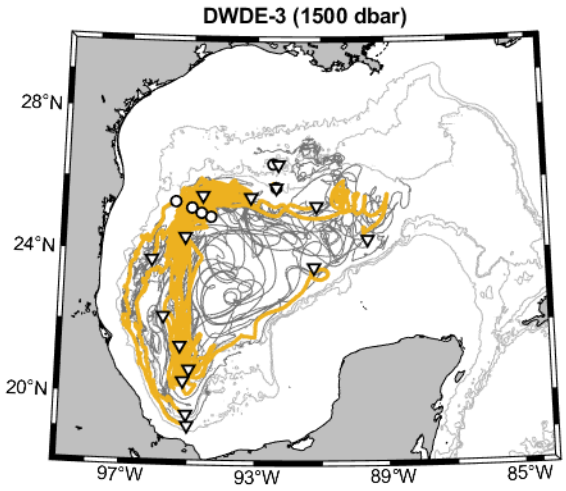

DWDE-2 (300 dbar)
28°N
24°N
20°N
97°W
93°W
89°W
85°W

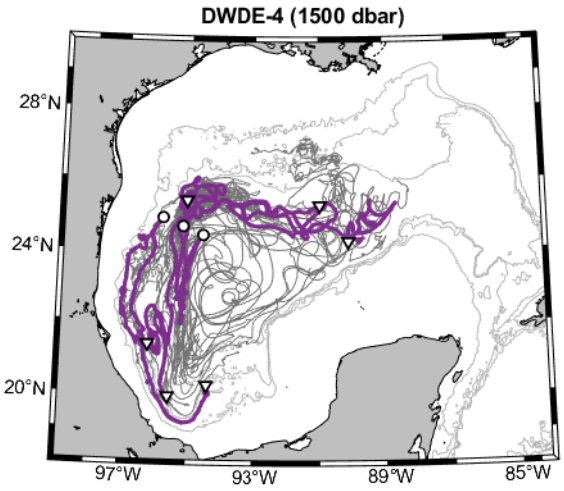

DWDE-3 (300 dbar)
28°N
24°N
20°N
97°W
93°W
89°W
85°W

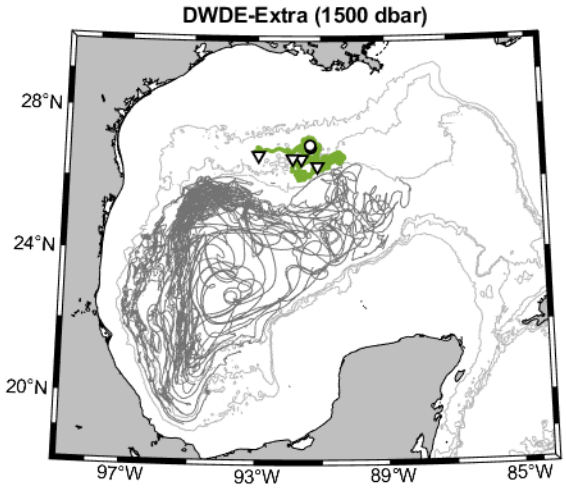

DWDE-4 (300 dbar)
28°N
24°N
20°N
97°W
93°W
89°W
85°W

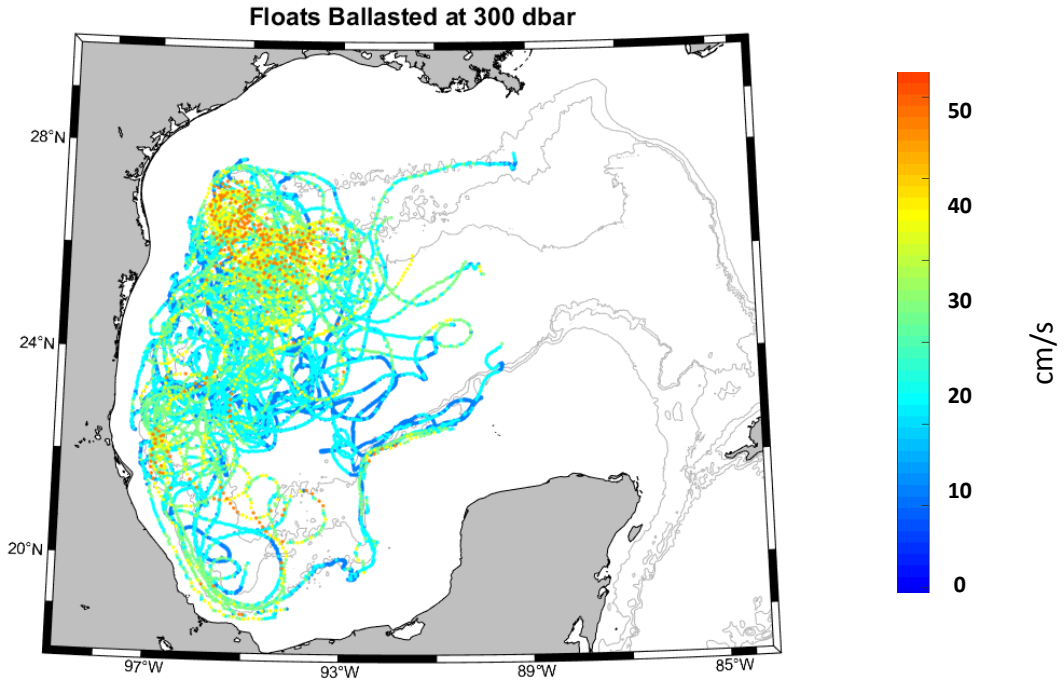

DWDE-1 (1500 dbar)
28°N
24°N
20°N
97°W
93°W
89°W
85°W

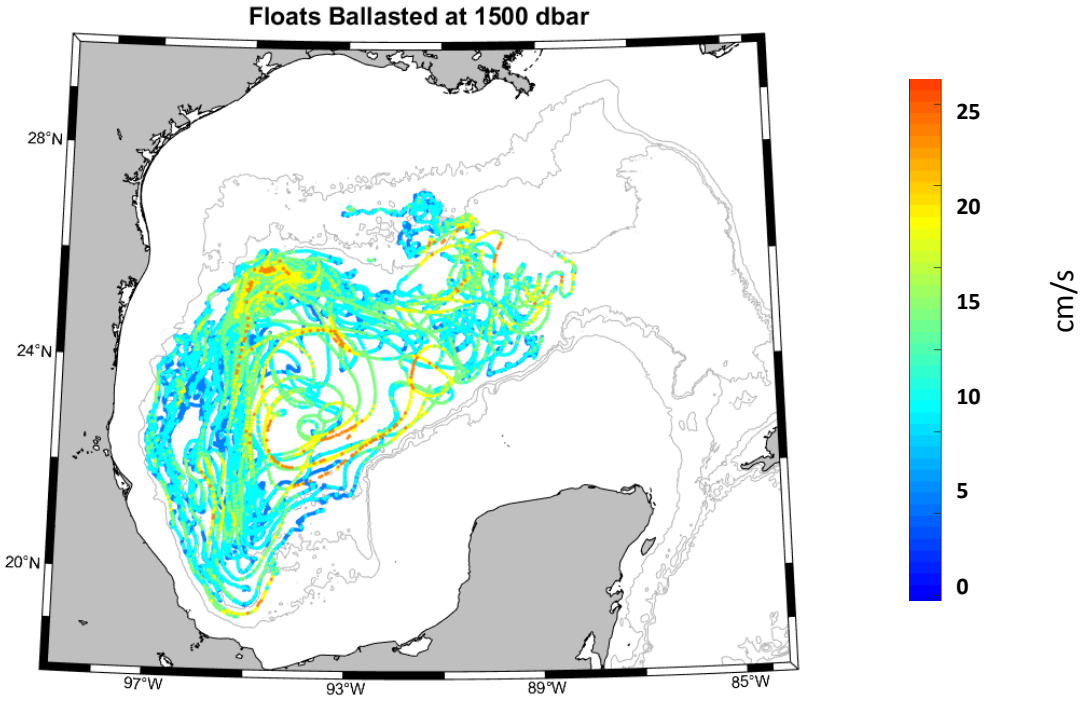

DWDE-2 (1500 dbar)
28°N
24°N
20°N
97°W
93°W
89°W
85°W


DWDE-3 (1500 dbar)
28°N
24°N
20°N
97°W
93°W
89°W
85°W


DWDE-4 (1500 dbar)
28°N
24°N
20°N
97°W
93°W
89°W
85°W

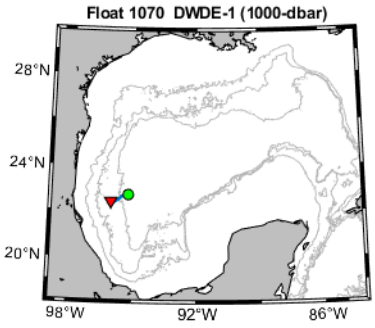

DWDE-Extra (1500 dbar)
28°N
24°N
20°N
97°W
93°W
89°W
85°W

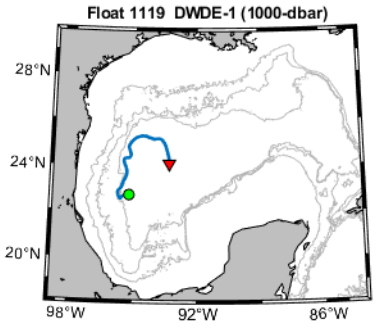

Floats Ballasted at 300 dbar
28°N
24°N
20°N
97°W
93°W
89°W
85°W
50
40
30
20
10
0
cm/s

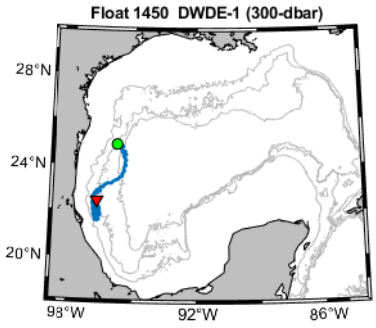

Floats Ballasted at 1500 dbar
28°N
24°N
20°N
97°W
93°W
89°W
85°W
25
20
15
10
5
0
cm/s

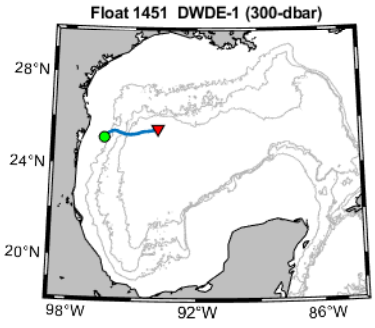
APPENDIX G: POSTAGE STAMPS

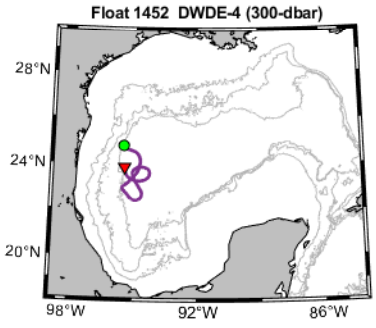
This appendix includes individual trajectory plots for each float, organized by float serial number. Each seeding is drawn as a different color: DWDE-1 (blue), DWDE-2 (orange), DWDE-3 (yellow), DWDE-4 (purple), DWDE-Extra (green). The deployment location is marked as a green circle, surface location as a red triangle. Bathymetry is drawn every 1000–m. Dashed black lines connect track segments where tracking was not possible due to lack of data or to sound source geometry.

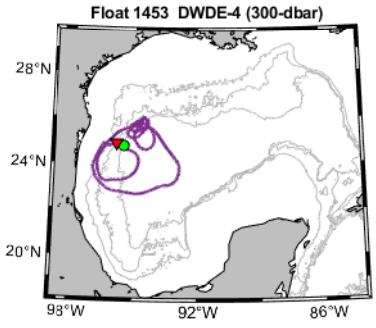

Float 1070 DWDE-1 (1000-dbar)
28°N
24°N
20°N
98°W
92°W
86°W

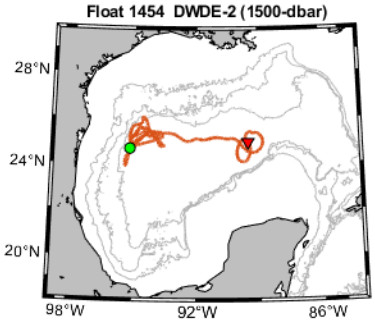

Float 1119 DWDE-1 (1000-dbar)
28°N
24°N
20°N
98°W
92°W
86°W

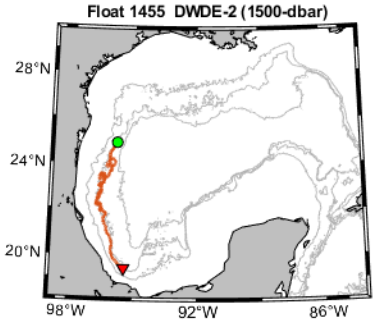

Float 1450 DWDE-1 (300-dbar)
28°N
24°N
20°N
98°W
92°W
86°W

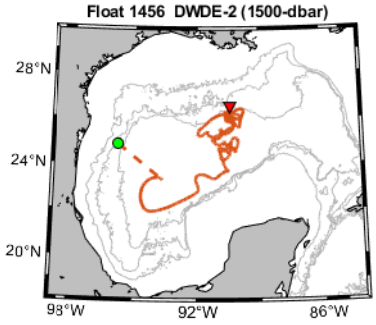

Float 1451 DWDE-1 (300-dbar)
28°N
24°N
20°N
98°W
92°W
86°W

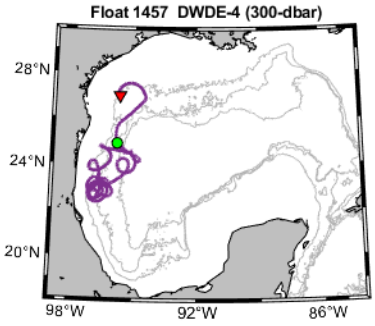

Float 1452 DWDE-4 (300-dbar)
28°N
24°N
20°N
98°W
92°W
86°W

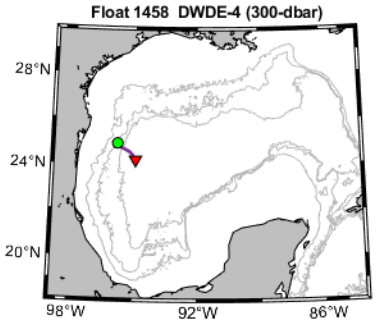

Float 1453 DWDE-4 (300-dbar)
28°N
24°N
20°N
98°W
92°W
86°W

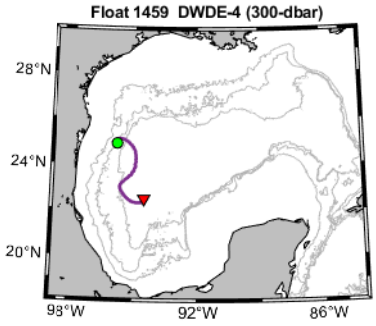

Float 1454 DWDE-2 (1500-dbar)
28°N
24°N
20°N
98°W
92°W
86°W

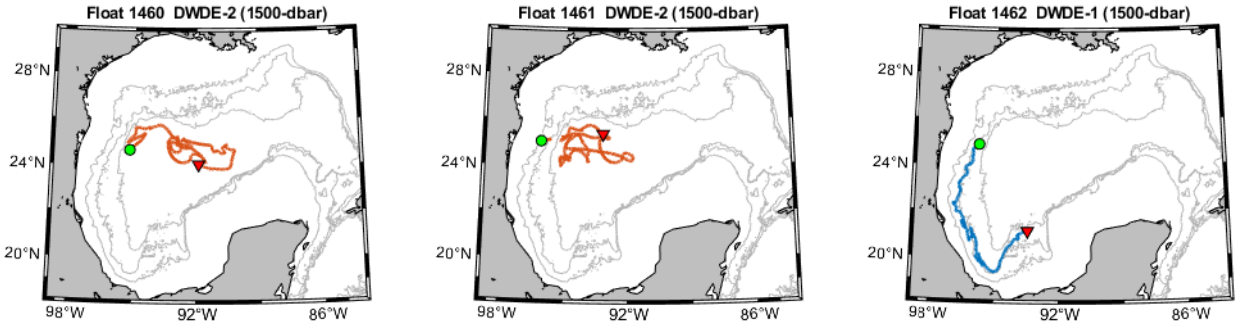

Float 1455 DWDE-2 (1500-dbar)
28°N
24°N
20°N
98°W
92°W
86°W

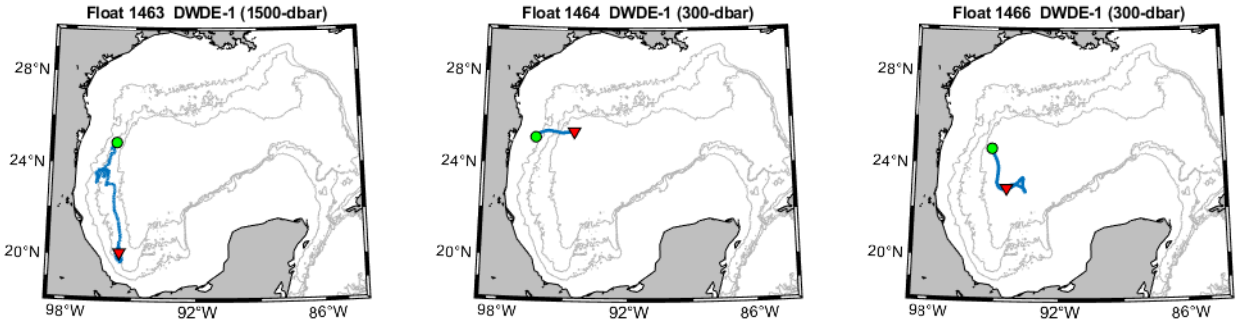

Float 1456 DWDE-2 (1500-dbar)
28°N
24°N
20°N
98°W
92°W
86°W

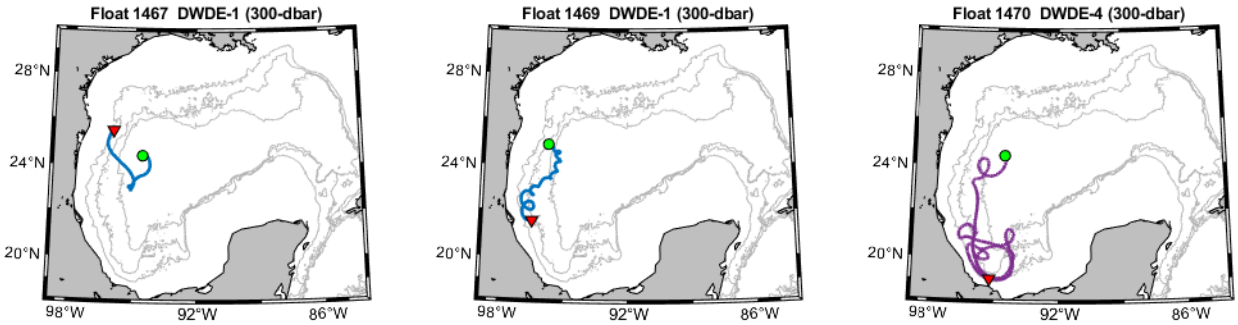

Float 1457 DWDE-4 (300-dbar)
28°N
24°N
20°N
98°W
92°W
86°W

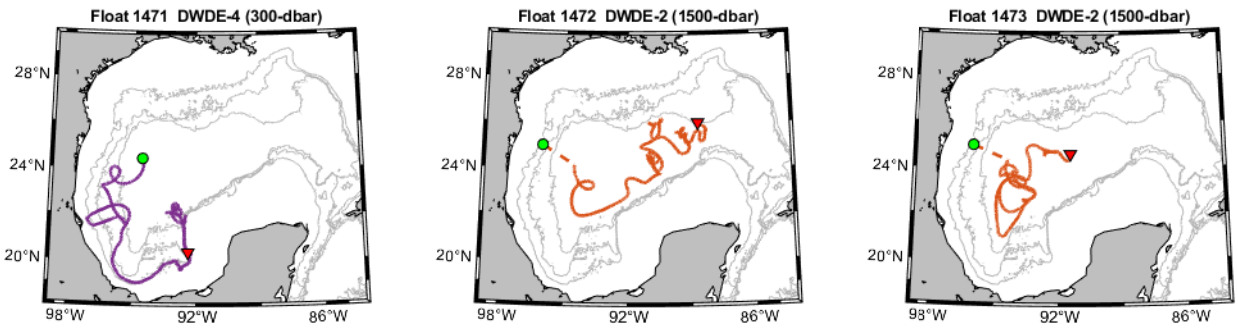

Float 1458 DWDE-4 (300-dbar)
28°N
24°N
20°N
98°W
92°W
86°W

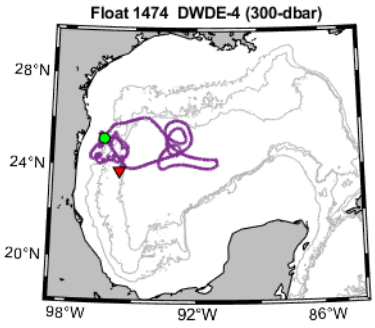

Float 1459 DWDE-4 (300-dbar)
28°N
24°N
20°N
98°W
92°W
86°W

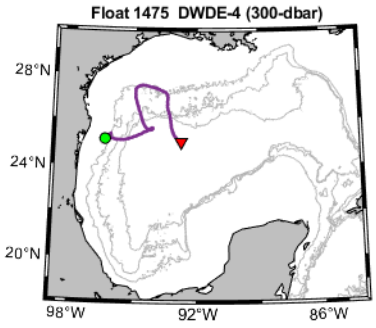

Float 1460 DWDE-2 (1500-dbar)
Float 1461 DWDE-2 (1500-dbar)
Float 1462 DWDE-1 (1500-dbar)
28°N
24°N
20°N
98°W
92°W
86°W

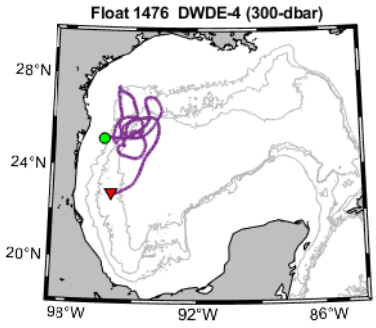

Float 1463 DWDE-1 (1500-dbar)
Float 1464 DWDE-1 (300-dbar)
Float 1466 DWDE-1 (300-dbar)
28°N
24°N
20°N
98°W
92°W
86°W

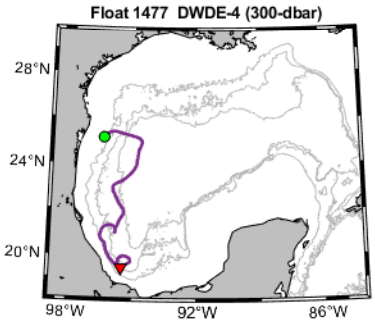

Float 1467 DWDE-1 (300-dbar)
Float 1469 DWDE-1 (300-dbar)
Float 1470 DWDE-4 (300-dbar)
28°N
24°N
20°N
98°W
92°W
86°W

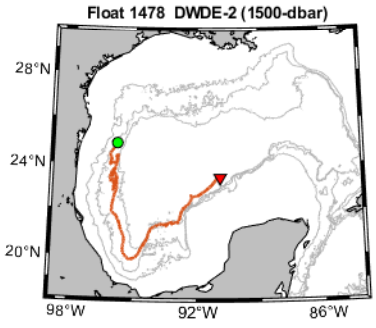

Float 1471 DWDE-4 (300-dbar)
Float 1472 DWDE-2 (1500-dbar)
Float 1473 DWDE-2 (1500-dbar)
28°N
24°N
20°N
98°W
92°W
86°W

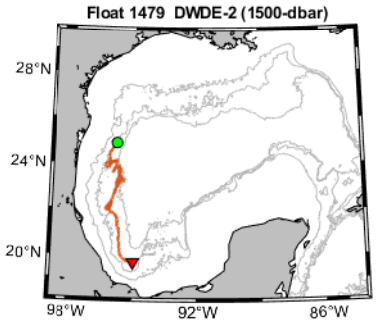

Float 1474 DWDE-4 (300-dbar)
28°N
24°N
20°N
98°W
92°W
86°W

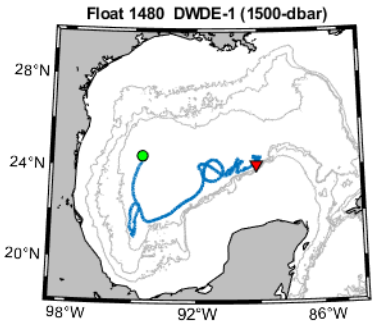

Float 1475 DWDE-4 (300-dbar)
28°N
24°N
20°N
98°W
92°W
86°W

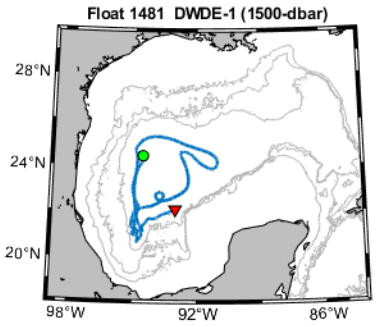

Float 1476 DWDE-4 (300-dbar)
28°N
24°N
20°N
98°W
92°W
86°W

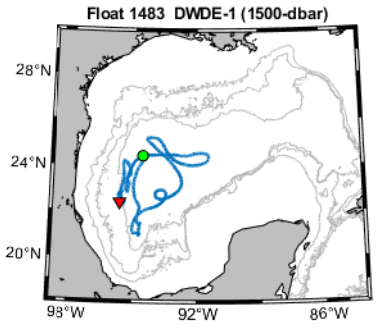

Float 1477 DWDE-4 (300-dbar)
28°N
24°N
20°N
98°W
92°W
86°W

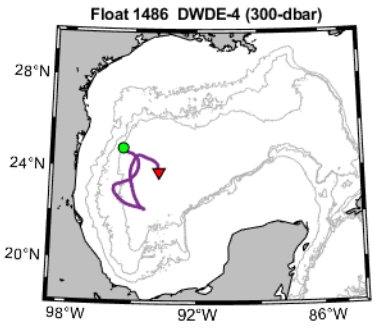

Float 1478 DWDE-2 (1500-dbar)
28°N
24°N
20°N
98°W
92°W
86°W

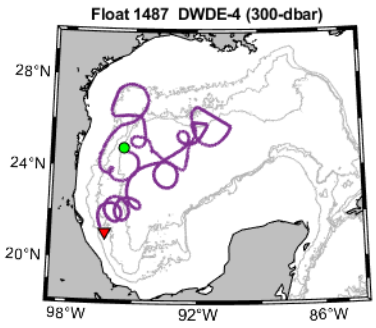

Float 1479 DWDE-2 (1500-dbar)
28°N
24°N
20°N
98°W
92°W
86°W

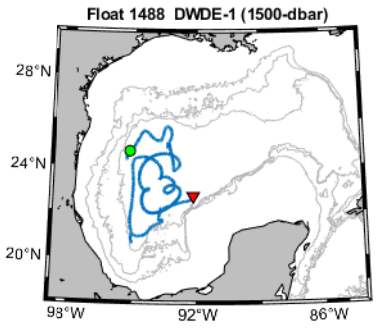

Float 1480 DWDE-1 (1500-dbar)
28°N
24°N
20°N
98°W
92°W
86°W

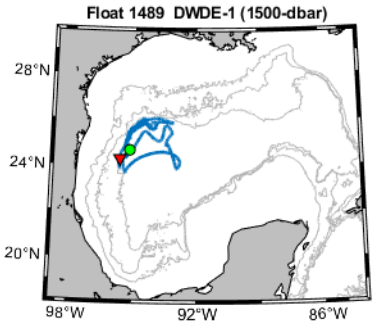

Float 1481 DWDE-1 (1500-dbar)
28°N
24°N
20°N
98°W
92°W
86°W

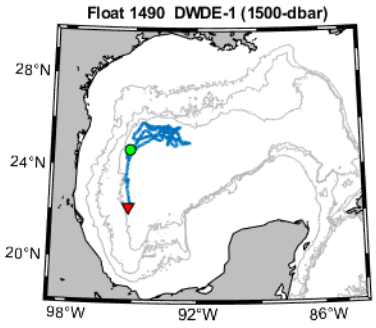

Float 1483 DWDE-1 (1500-dbar)
28°N
24°N
20°N
98°W
92°W
86°W

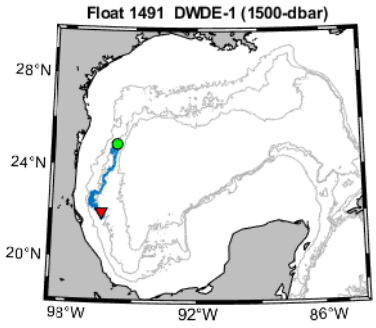

Float 1486 DWDE-4 (300-dbar)
28°N
24°N
20°N
98°W
92°W
86°W

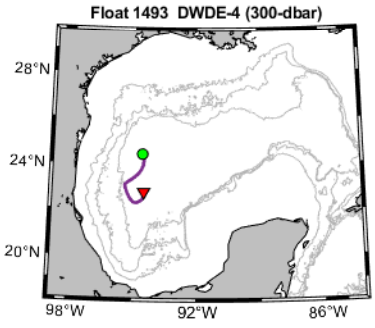

Float 1487 DWDE-4 (300-dbar)
28°N
24°N
20°N
98°W
92°W
86°W

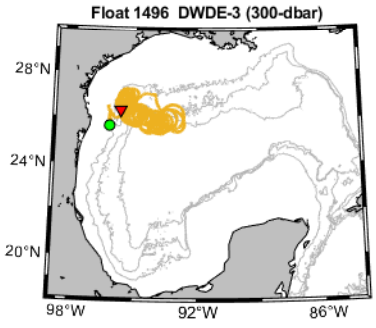

Float 1488 DWDE-1 (1500-dbar)
28°N
24°N
20°N
98°W
92°W
86°W

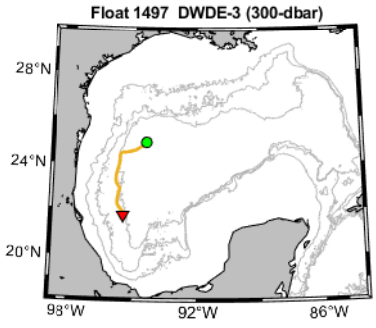

Float 1489 DWDE-1 (1500-dbar)
28°N
24°N
20°N
98°W
92°W
86°W

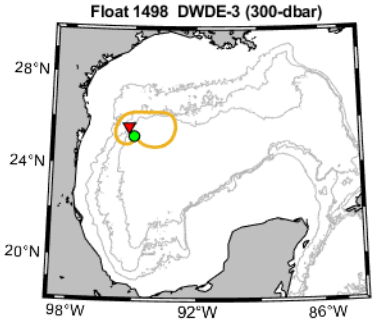

Float 1490 DWDE-1 (1500-dbar)
28°N
24°N
20°N
98°W
92°W
86°W

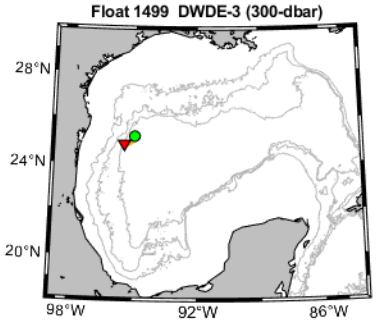

Float 1491 DWDE-1 (1500-dbar)
28°N
24°N
20°N
98°W
92°W
86°W

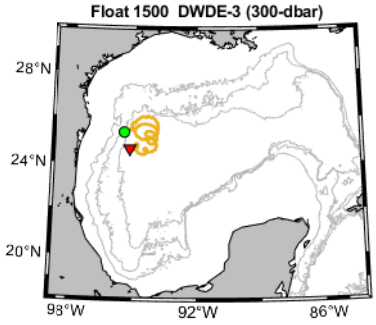

Float 1493 DWDE-4 (300-dbar)
28°N
24°N
20°N
98°W
92°W
86°W

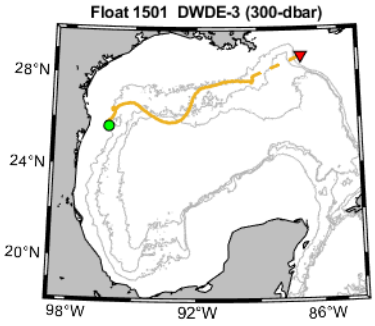

Float 1496 DWDE-3 (300-dbar)
28°N
24°N
20°N
98°W
92°W
86°W

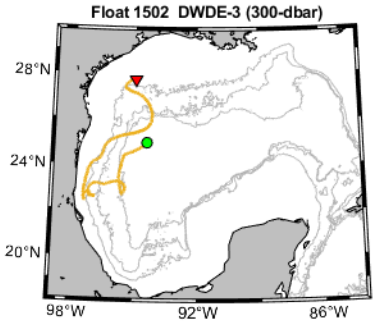

Float 1497 DWDE-3 (300-dbar)
28°N
24°N
20°N
98°W
92°W
86°W

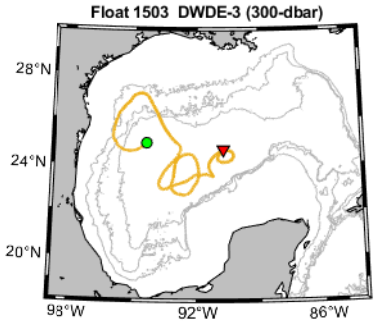

Float 1498 DWDE-3 (300-dbar)
28°N
24°N
20°N
98°W
92°W
86°W

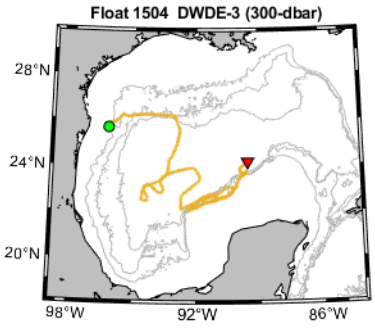

Float 1499 DWDE-3 (300-dbar)
28°N
24°N
20°N
98°W
92°W
86°W

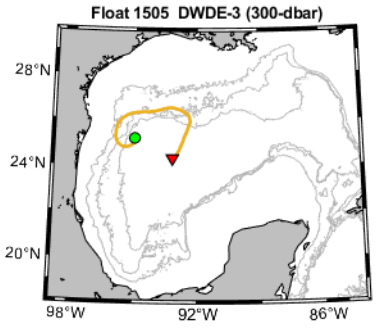

Float 1500 DWDE-3 (300-dbar)
28°N
24°N
20°N
98°W
92°W
86°W

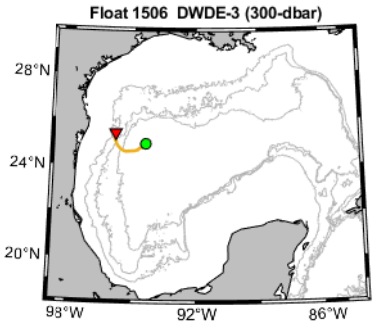

Float 1501 DWDE-3 (300-dbar)
28°N
24°N
20°N
98°W
92°W
86°W

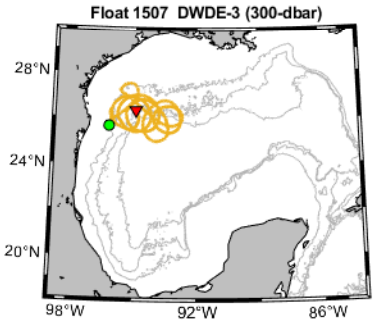

Float 1502 DWDE-3 (300-dbar)
28°N
24°N
20°N
98°W
92°W
86°W

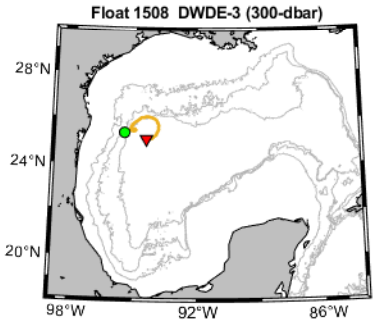

Float 1503 DWDE-3 (300-dbar)
28°N
24°N
20°N
98°W
92°W
86°W

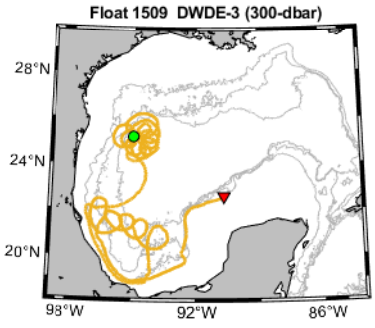

Float 1504 DWDE-3 (300-dbar)
28°N
24°N
20°N
98°W
92°W
86°W

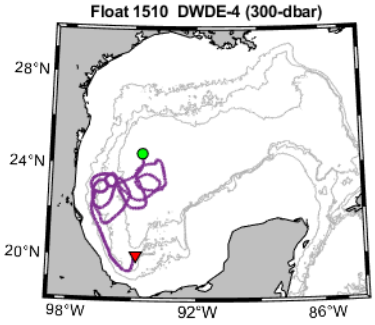

Float 1505 DWDE-3 (300-dbar)
28°N
24°N
20°N
98°W
92°W
86°W

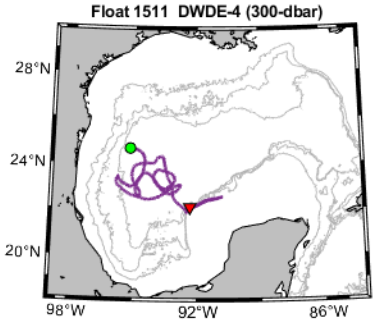

Float 1506 DWDE-3 (300-dbar)
28°N
24°N
20°N
98°W
92°W
86°W

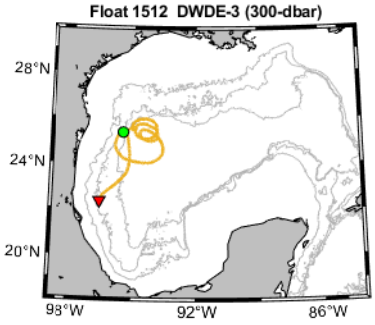

Float 1507 DWDE-3 (300-dbar)
28°N
24°N
20°N
98°W
92°W
86°W

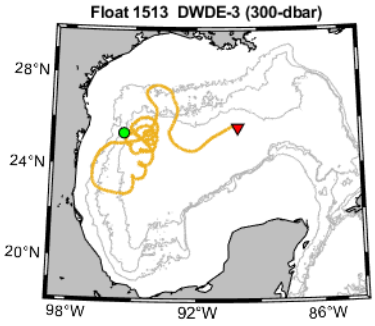

Float 1508 DWDE-3 (300-dbar)
28°N
24°N
20°N
98°W
92°W
86°W

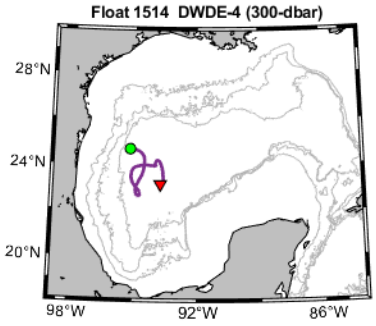

Float 1509 DWDE-3 (300-dbar)
28°N
24°N
20°N
98°W
92°W
86°W

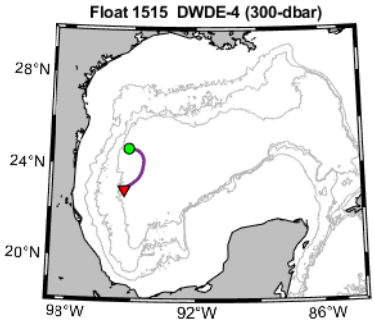

Float 1510 DWDE-4 (300-dbar)
28°N
24°N
20°N
98°W
92°W
86°W

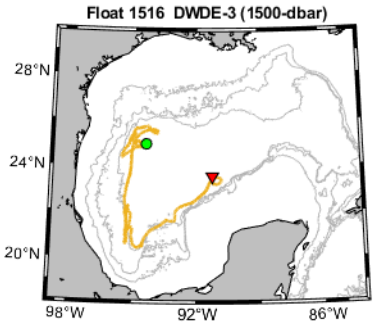

Float 1511 DWDE-4 (300-dbar)
28°N
24°N
20°N
98°W
92°W
86°W

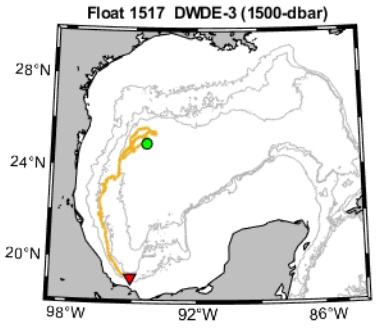

Float 1512 DWDE-3 (300-dbar)
28°N
24°N
20°N
98°W
92°W
86°W

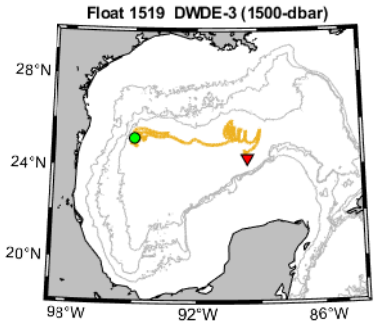

Float 1513 DWDE-3 (300-dbar)
28°N
24°N
20°N
98°W
92°W
86°W

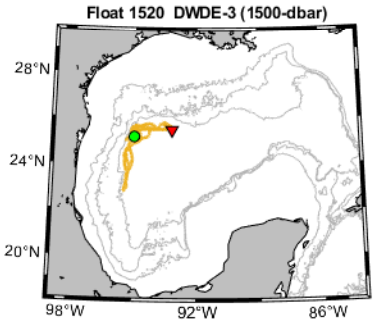

Float 1514 DWDE-4 (300-dbar)
28°N
24°N
20°N
98°W
92°W
86°W

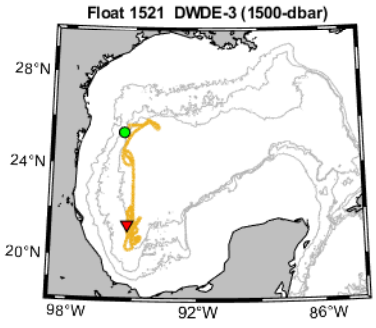

Float 1515 DWDE-4 (300-dbar)
28°N
24°N
20°N
98°W
92°W
86°W

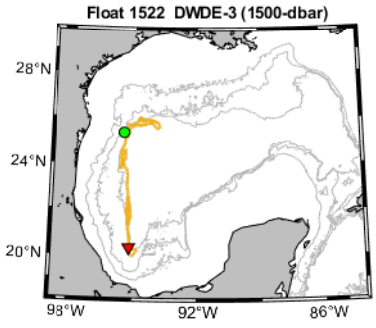

Float 1516 DWDE-3 (1500-dbar)
28°N
24°N
20°N
98°W
92°W
86°W

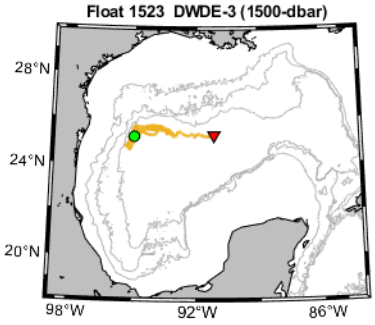

Float 1517 DWDE-3 (1500-dbar)
28°N
24°N
20°N
98°W
92°W
86°W

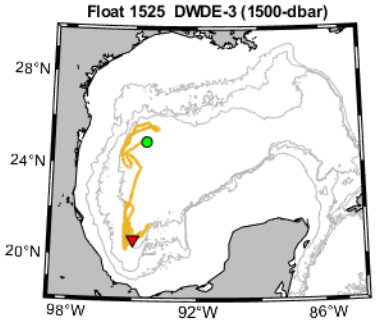

Float 1519 DWDE-3 (1500-dbar)
28°N
24°N
20°N
98°W
92°W
86°W

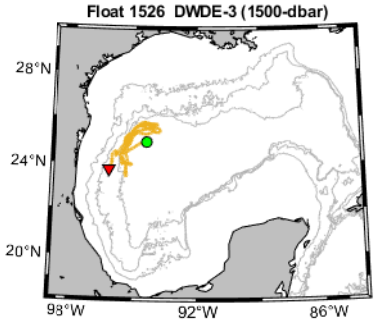

Float 1520 DWDE-3 (1500-dbar)
28°N
24°N
20°N
98°W
92°W
86°W

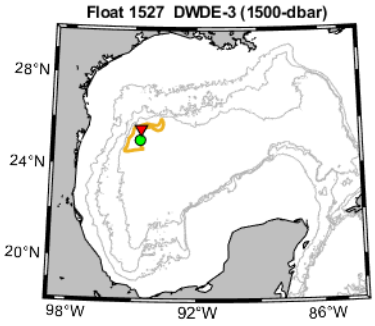

Float 1521 DWDE-3 (1500-dbar)
28°N
24°N
20°N
98°W
92°W
86°W

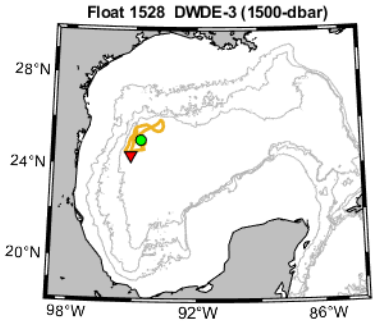

Float 1522 DWDE-3 (1500-dbar)
28°N
24°N
20°N
98°W
92°W
86°W

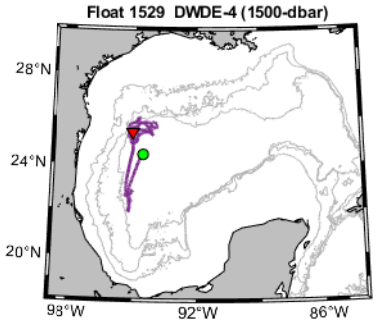

Float 1523 DWDE-3 (1500-dbar)
28°N
24°N
20°N
98°W
92°W
86°W

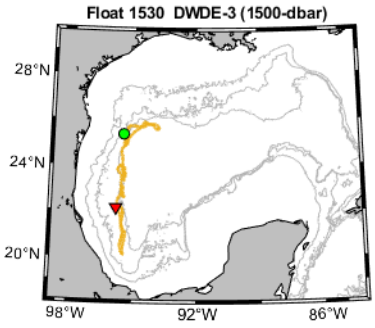

Float 1525 DWDE-3 (1500-dbar)
28°N
24°N
20°N
98°W
92°W
86°W

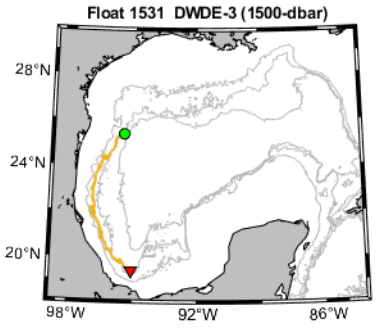

Float 1526 DWDE-3 (1500-dbar)
28°N
24°N
20°N
98°W
92°W
86°W

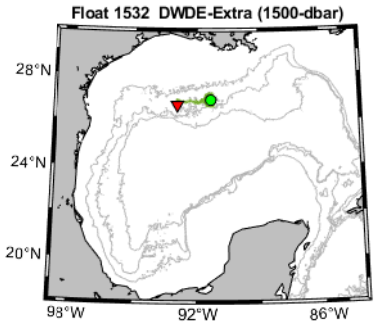

Float 1527 DWDE-3 (1500-dbar)
28°N
24°N
20°N
98°W
92°W
86°W

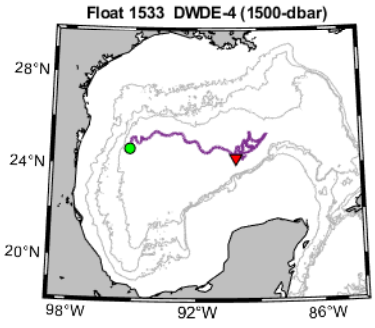

Float 1528 DWDE-3 (1500-dbar)
28°N
24°N
20°N
98°W
92°W
86°W

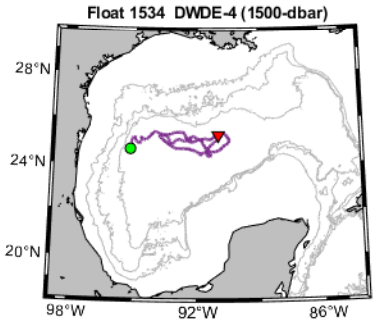

Float 1529 DWDE-4 (1500-dbar)
28°N
24°N
20°N
98°W
92°W
86°W

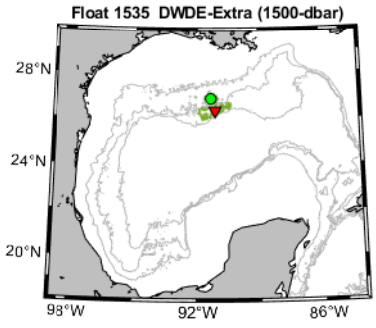

Float 1530 DWDE-3 (1500-dbar)
28°N
24°N
20°N
98°W
92°W
86°W

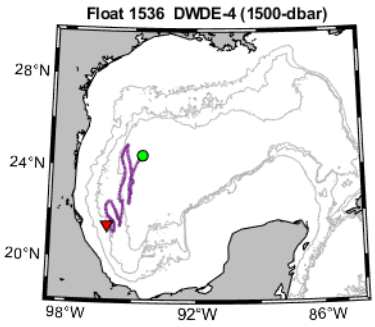

Float 1531 DWDE-3 (1500-dbar)
28°N
24°N
20°N
98°W
92°W
86°W

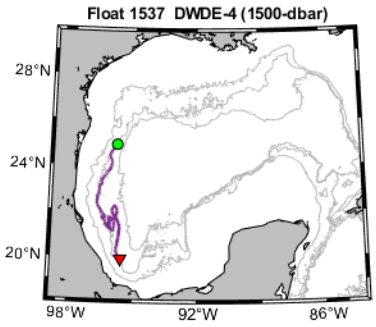

Float 1532 DWDE-Extra (1500-dbar)
28°N
24°N
20°N
98°W
92°W
86°W

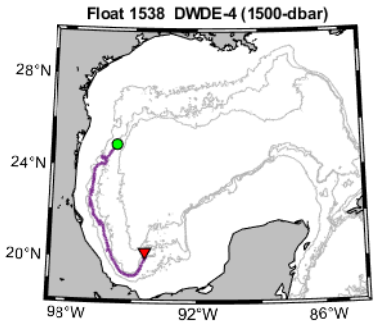

Float 1533 DWDE-4 (1500-dbar)
28°N
24°N
20°N
98°W
92°W
86°W

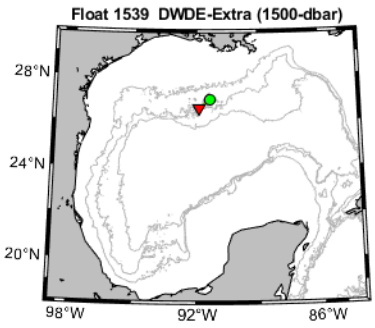

Float 1534 DWDE-4 (1500-dbar)
28°N
24°N
20°N
98°W
92°W
86°W

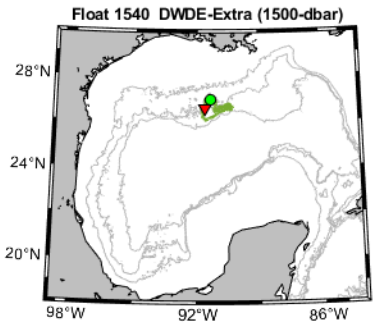

Float 1535 DWDE-Extra (1500-dbar)
28°N
24°N
20°N
98°W
92°W
86°W


Float 1536 DWDE-4 (1500-dbar)
28°N
24°N
20°N
98°W
92°W
86°W


Float 1537 DWDE-4 (1500-dbar)
28°N
24°N
20°N
98°W
92°W
86°W

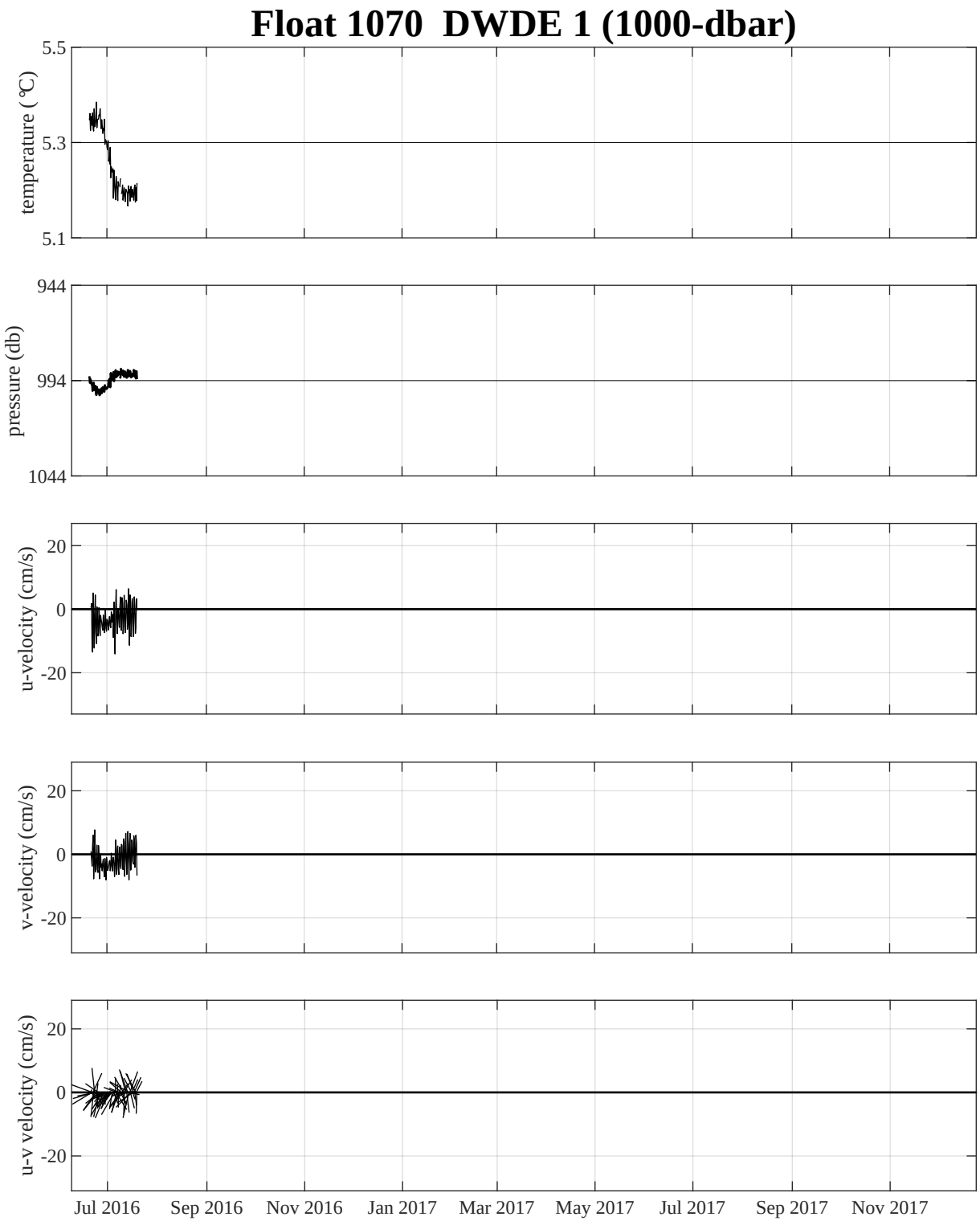

Float 1538 DWDE-4 (1500-dbar)
28°N
24°N
20°N
98°W
92°W
86°W

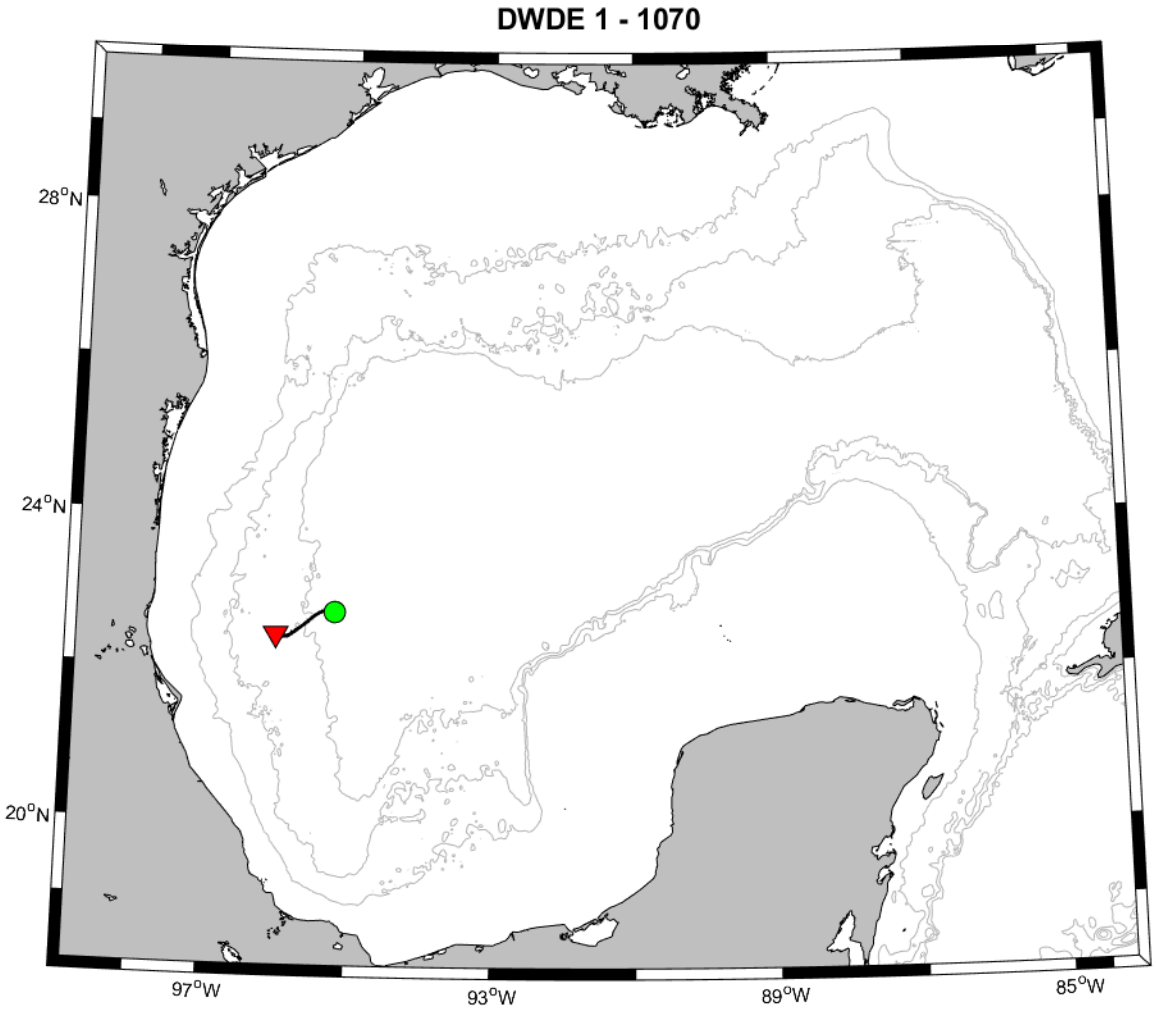

Float 1539 DWDE-Extra (1500-dbar)
28°N
24°N
20°N
98°W
92°W
86°W

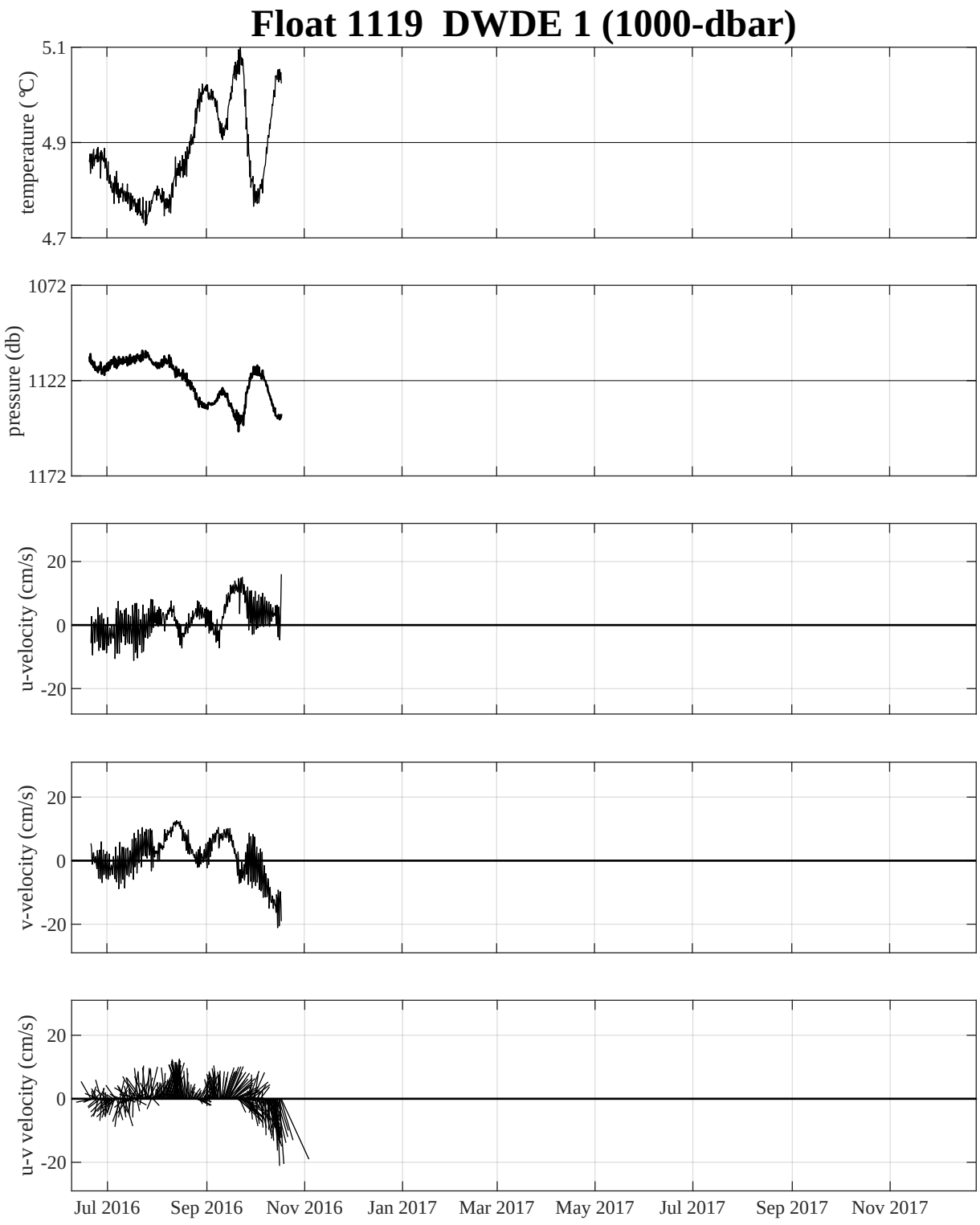

Float 1540 DWDE-Extra (1500-dbar)
28°N
24°N
20°N
98°W
92°W
86°W

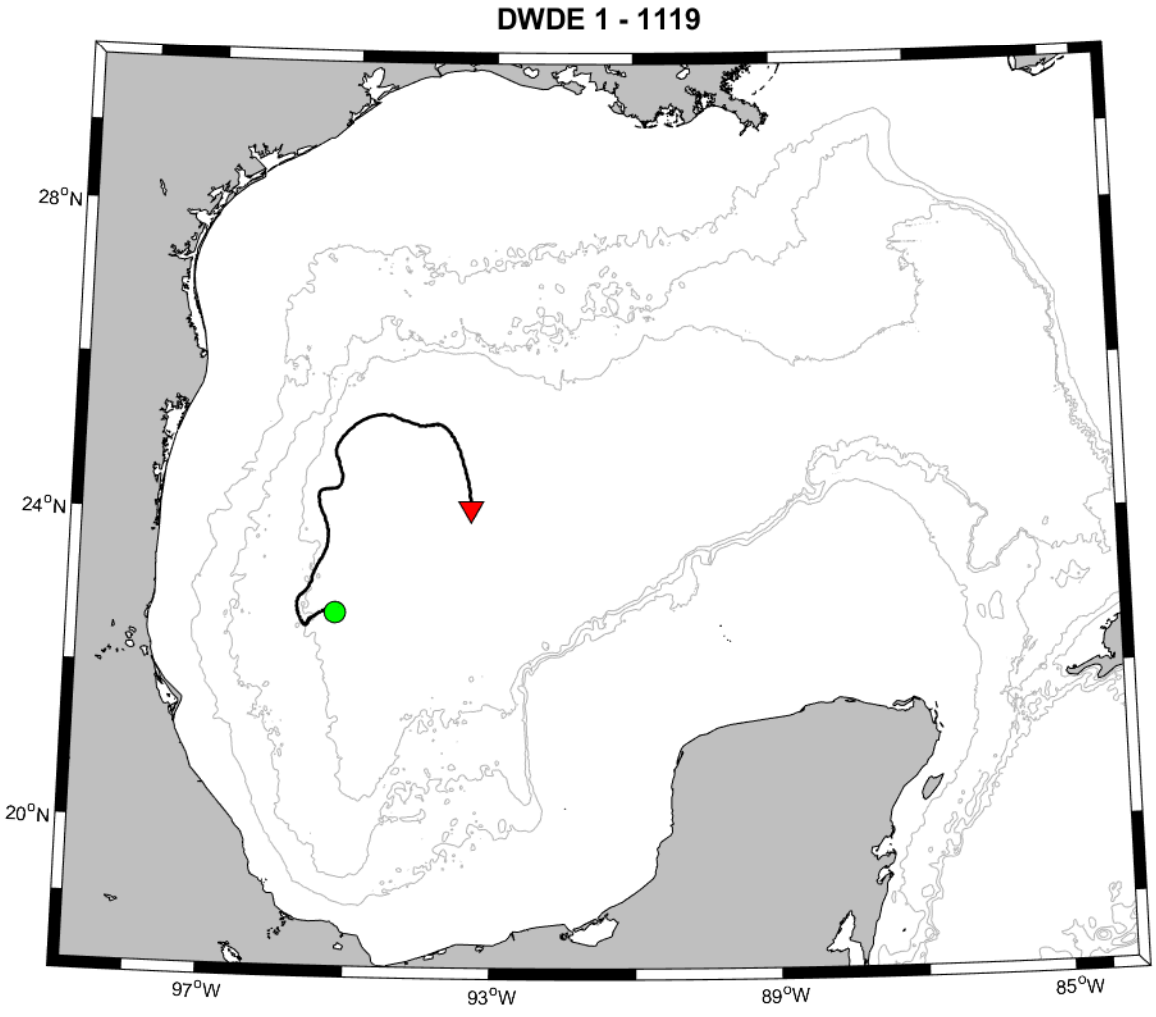
APPENDIX H: PROPERTY AND TRAJECTORY PLOTS

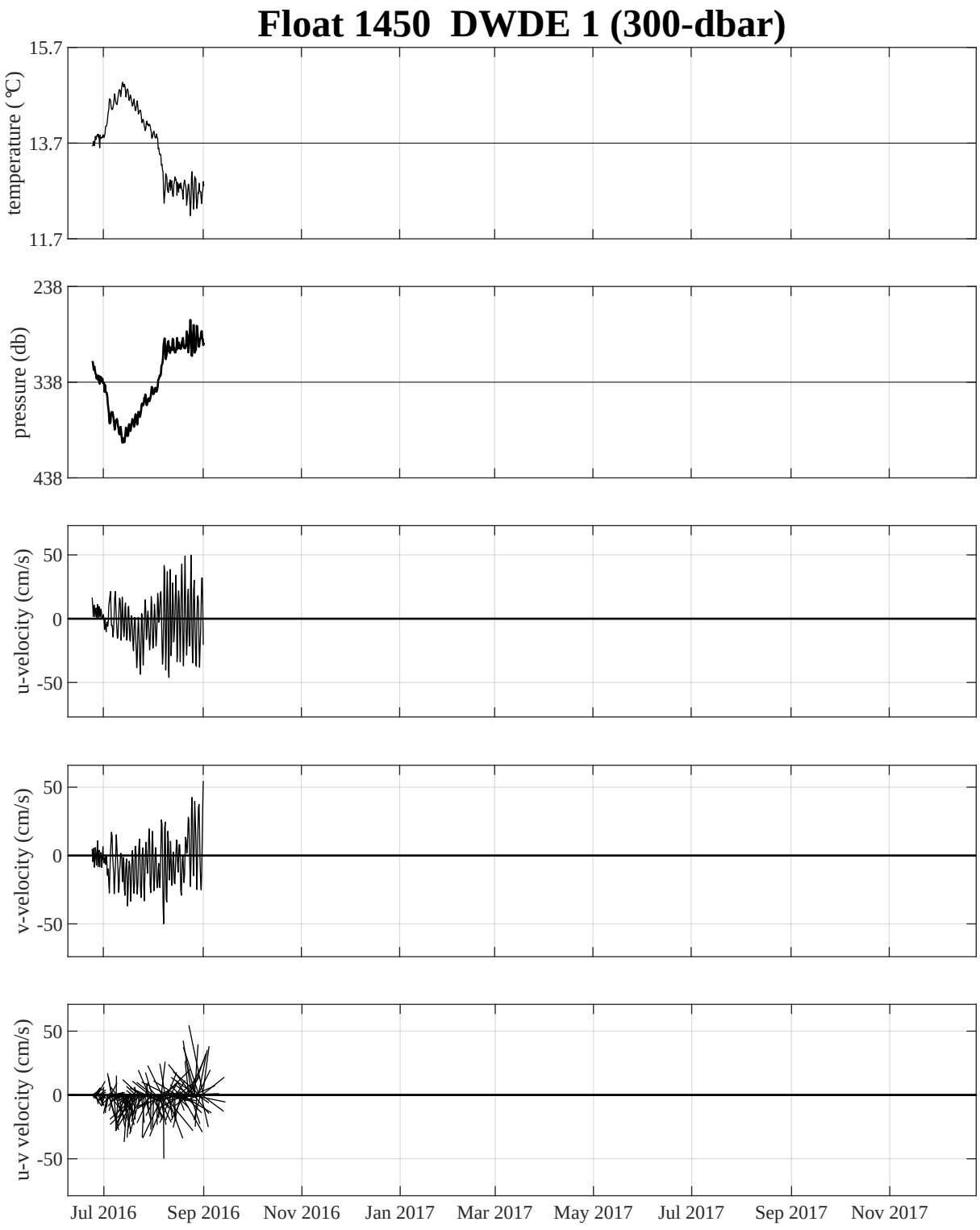
This appendix includes individual trajectory and property plots for each float, organized by float serial number. On the trajectory plots, the deployment location is marked as a green circle, surface location as a red triangle. Bathymetry is drawn every 1000 –m. Dashed black lines connect track segments where tracking was not possible due to lack of data or to sound source geometry. The companion property plot contains in situ temperature, pressure, u- and v-velocities, and vector velocities for the float's underwater mission length. If blank space exists, this indicates that the float was programmed to do a longer mission than data were recorded.

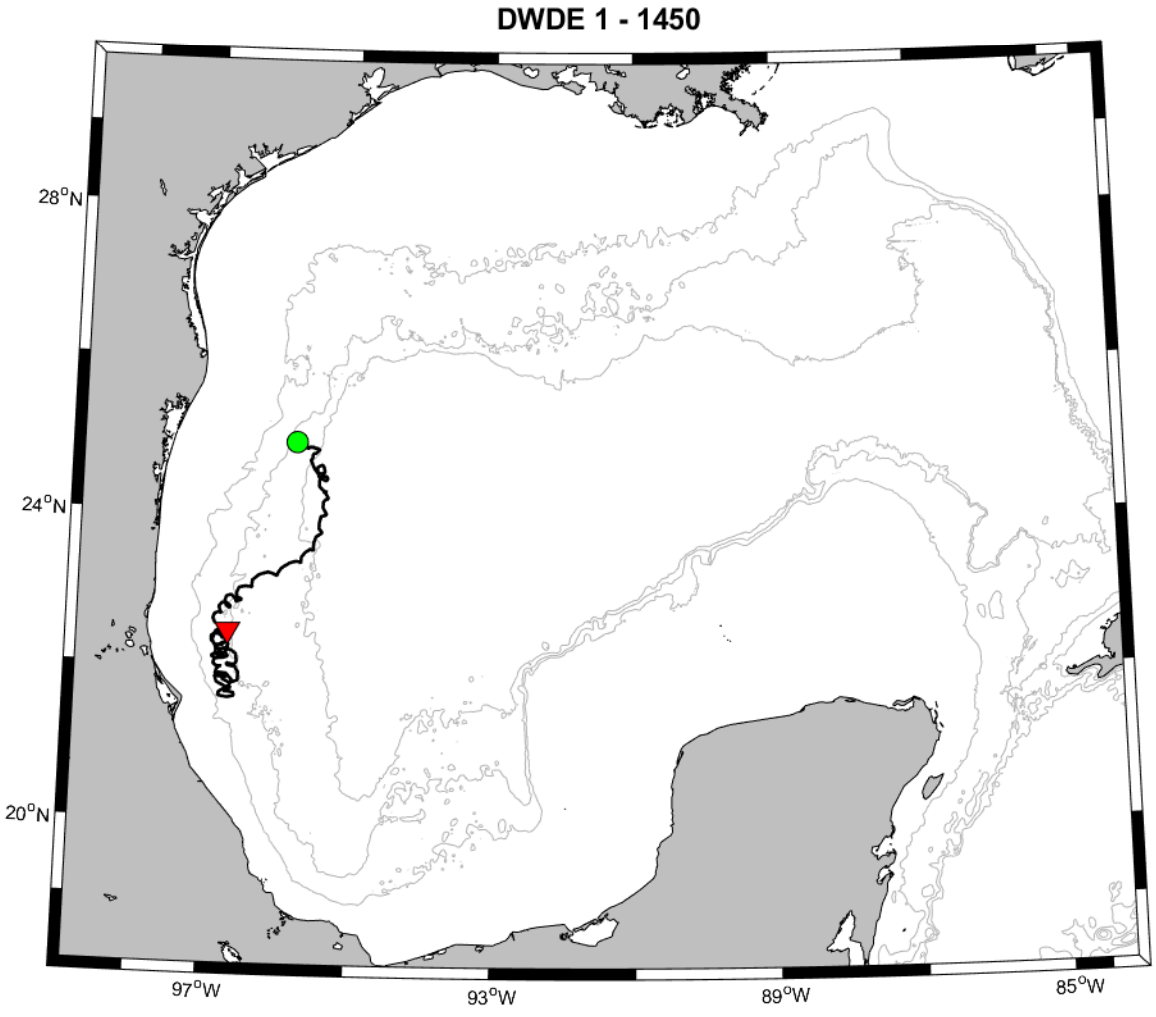

Float 1070 DWDE 1 (1000-dbar)
temperature (℃)
5.5
5.3
5.1
pressure (db)
944
994
1044
u-velocity (cm/s)
20
0
-20
v-velocity (cm/s)
20
0
-20
u-v velocity (cm/s)
20
0
-20
Jul 2016
Sep 2016
Nov 2016
Jan 2017
Mar 2017
May 2017
Jul 2017
Sep 2017
Nov 2017

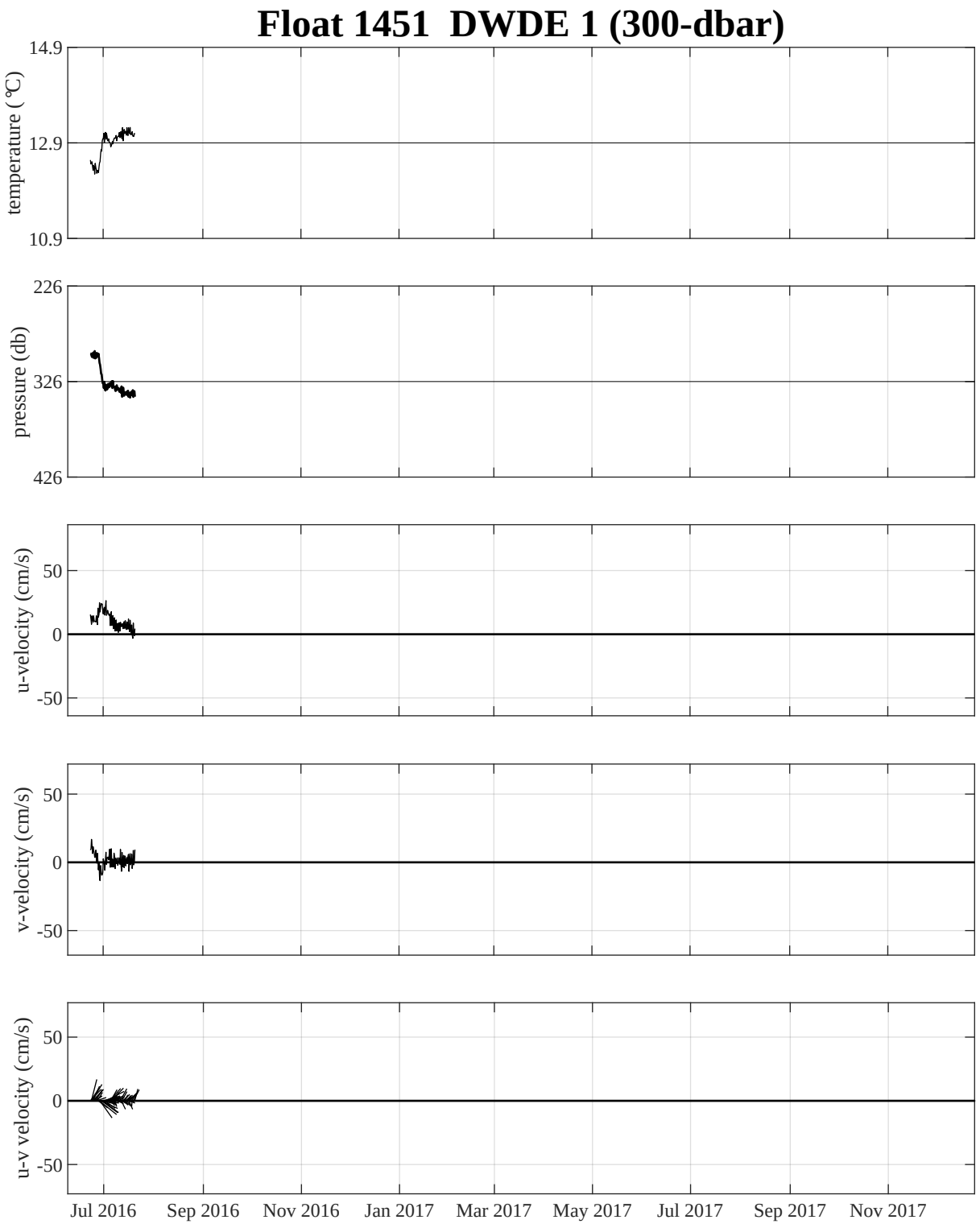

DWDE 1 - 1070
28°N
24°N
20°N
97°W
93°W
89°W
85°W

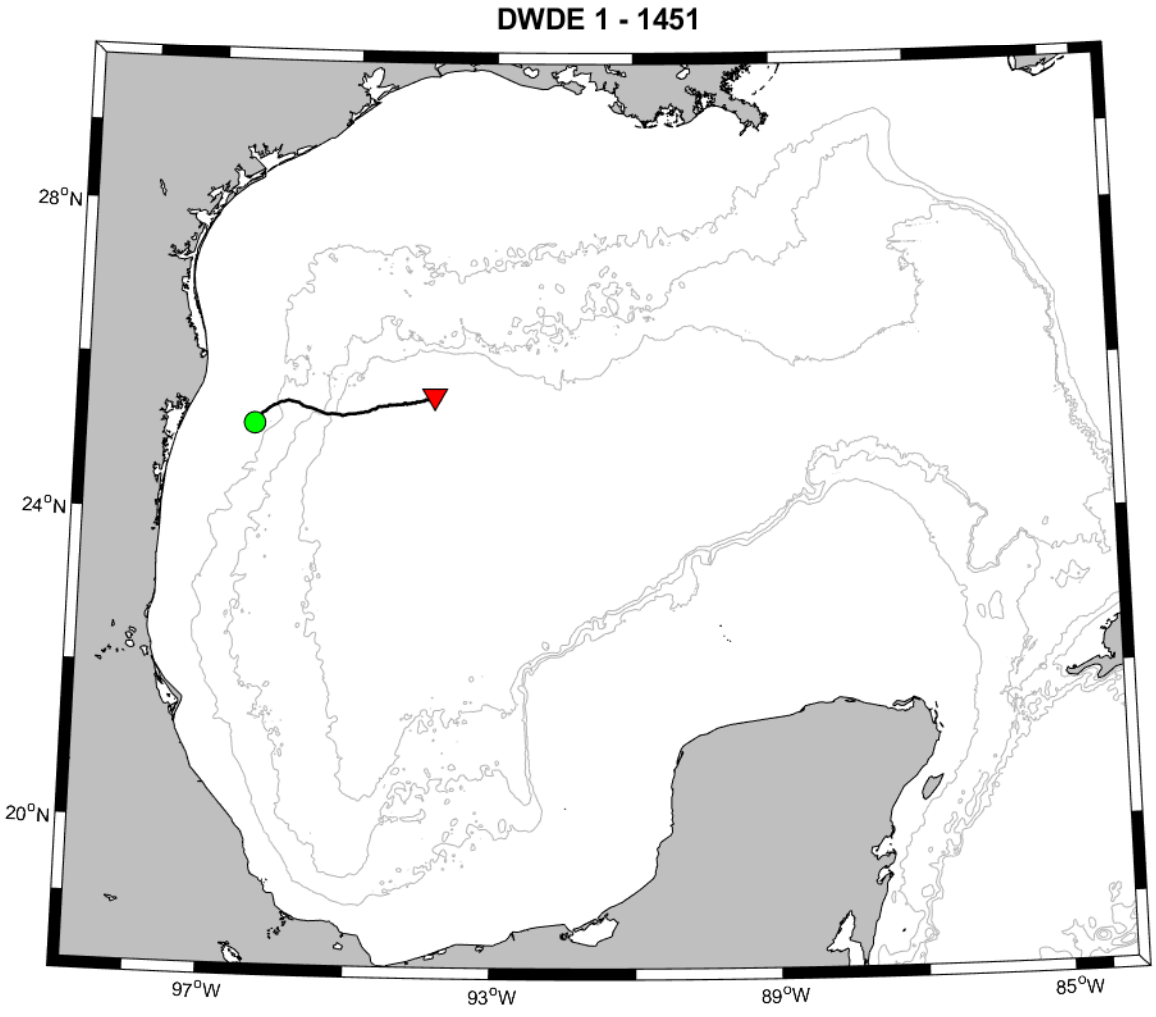

Float 1119 DWDE 1 (1000-dbar)
temperature (℃)
5.1
4.9
4.7
pressure (db)
1072
1122
1172
u-velocity (cm/s)
20
0
-20
v-velocity (cm/s)
20
0
-20
u-v velocity (cm/s)
20
0
-20
Jul 2016
Sep 2016
Nov 2016
Jan 2017
Mar 2017
May 2017
Jul 2017
Sep 2017
Nov 2017

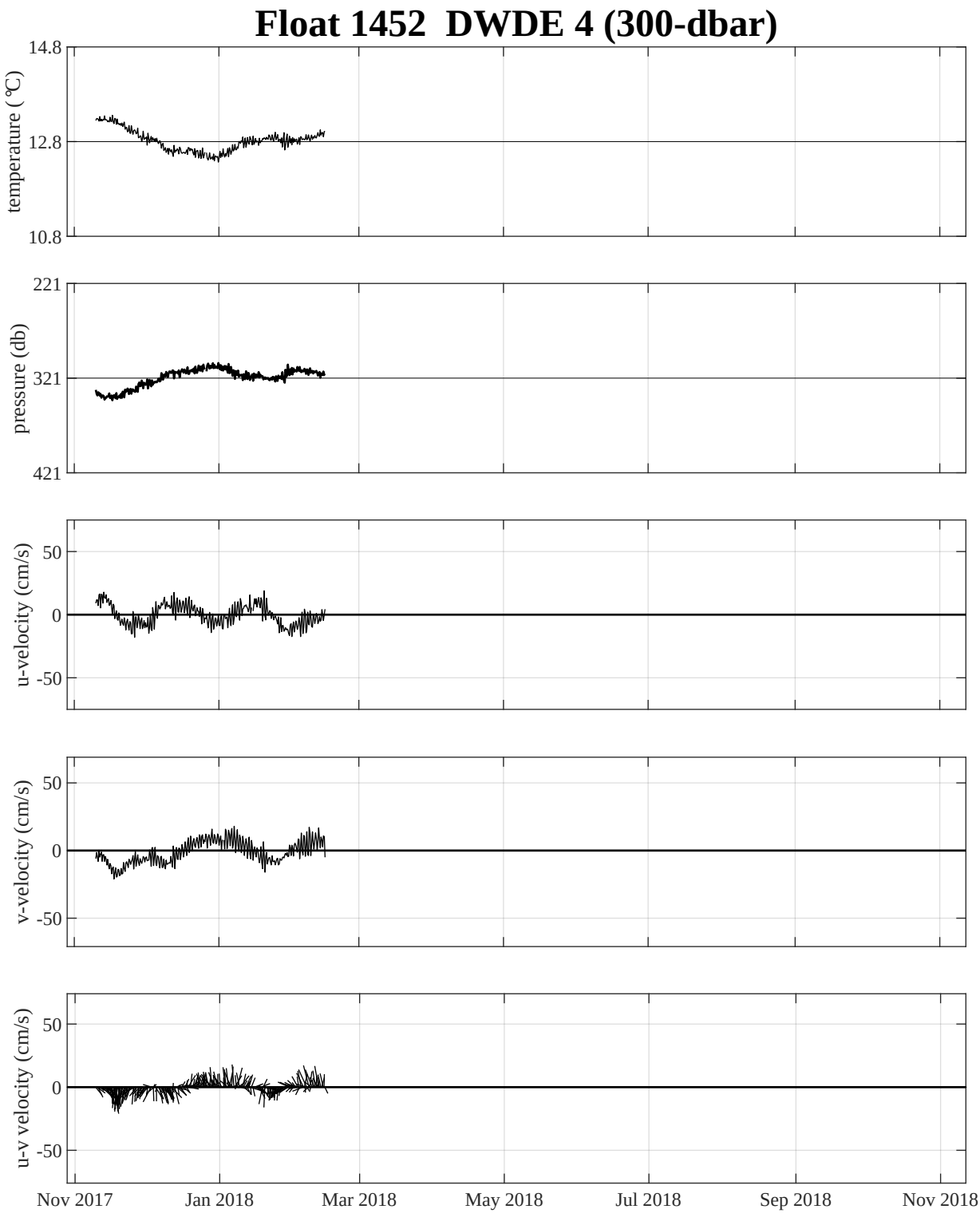

DWDE 1 - 1119
28°N
24°N
20°N
97°W
93°W
89°W
85°W

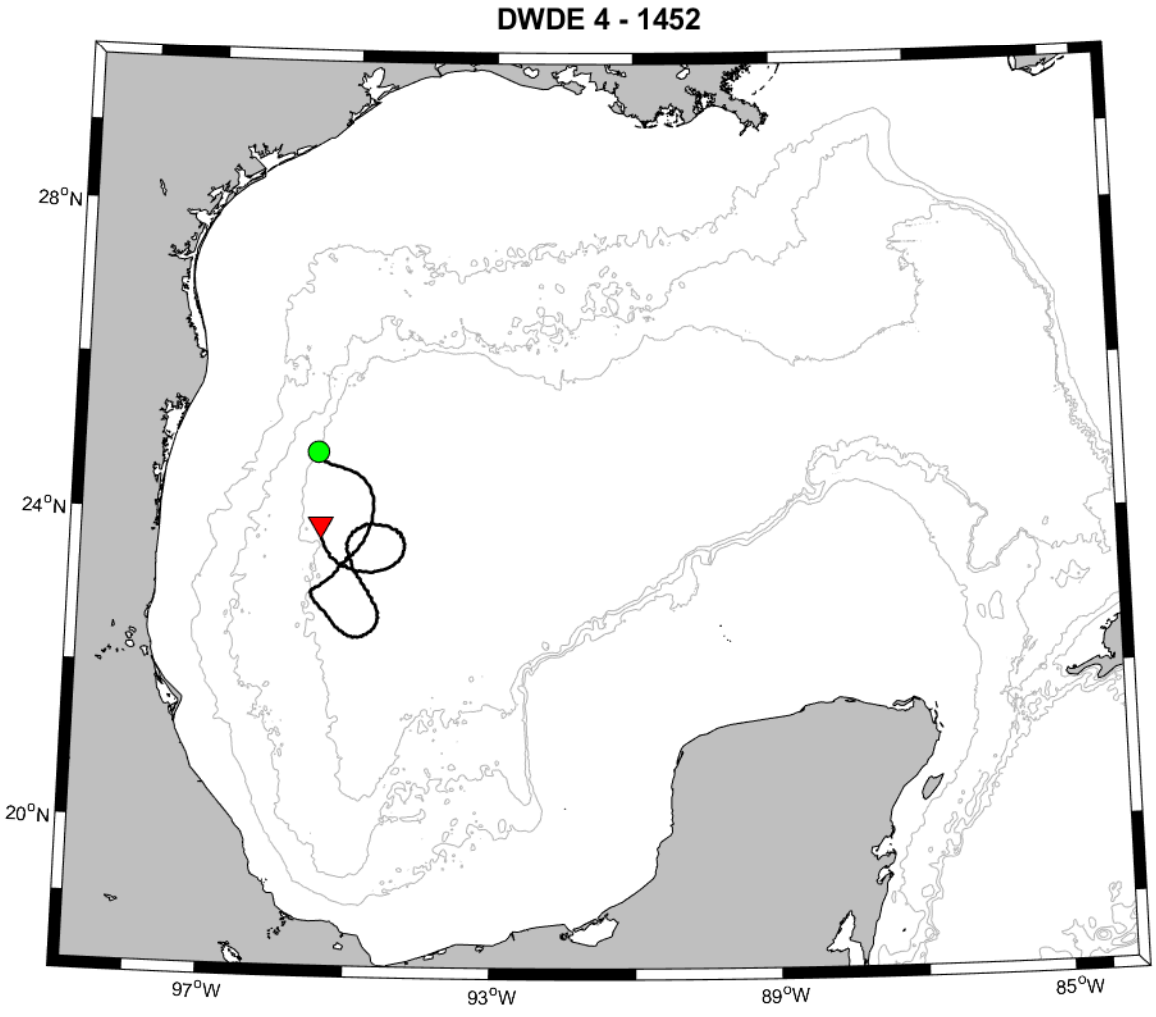

Float 1450 DWDE 1 (300-dbar)
temperature (℃)
15.7
13.7
11.7
pressure (db)
238
338
438
u-velocity (cm/s)
50
0
-50
v-velocity (cm/s)
50
0
-50
u-v velocity (cm/s)
50
0
-50
Jul 2016
Sep 2016
Nov 2016
Jan 2017
Mar 2017
May 2017
Jul 2017
Sep 2017
Nov 2017

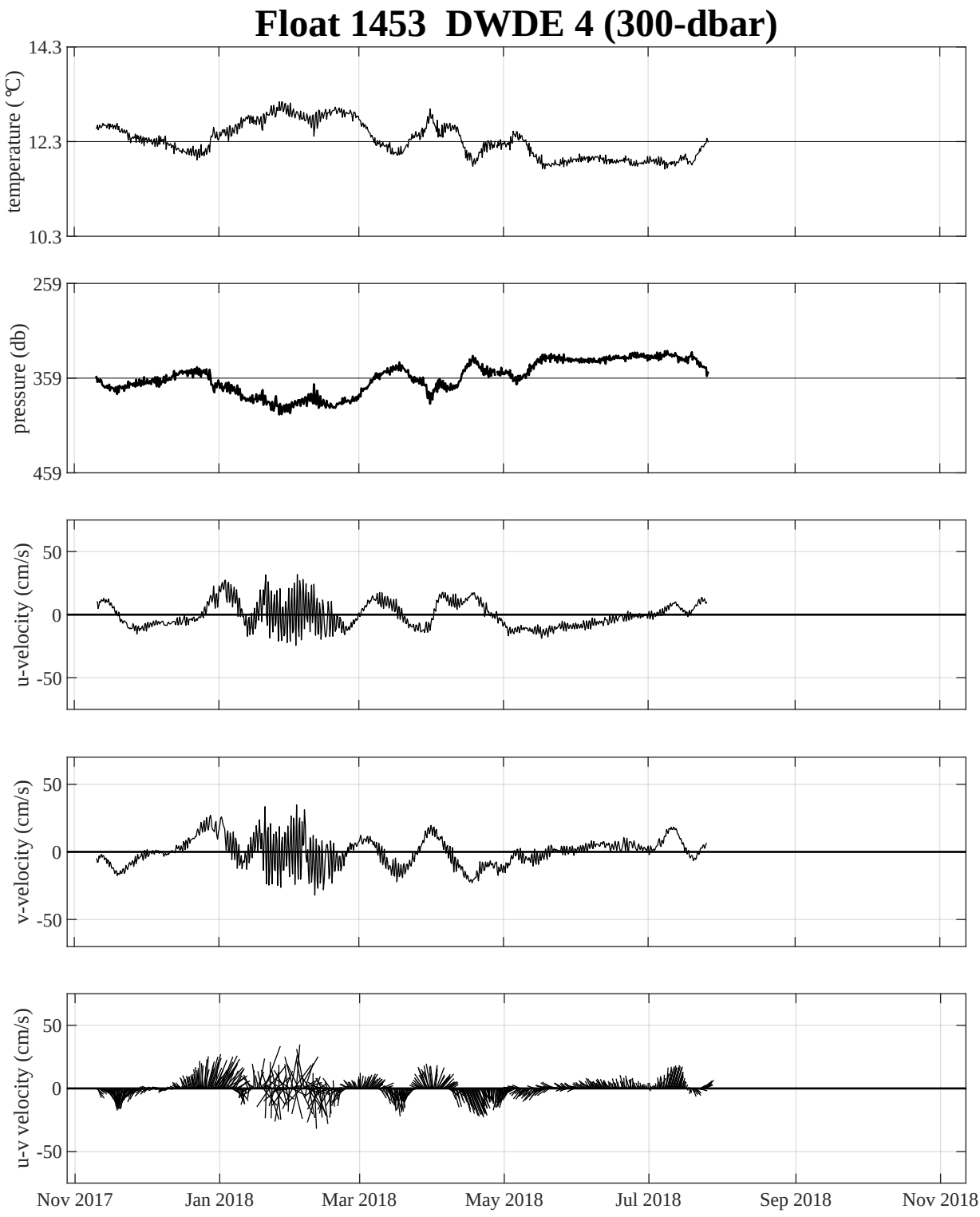

DWDE 1 - 1450
28°N
24°N
20°N
97°W
93°W
89°W
85°W

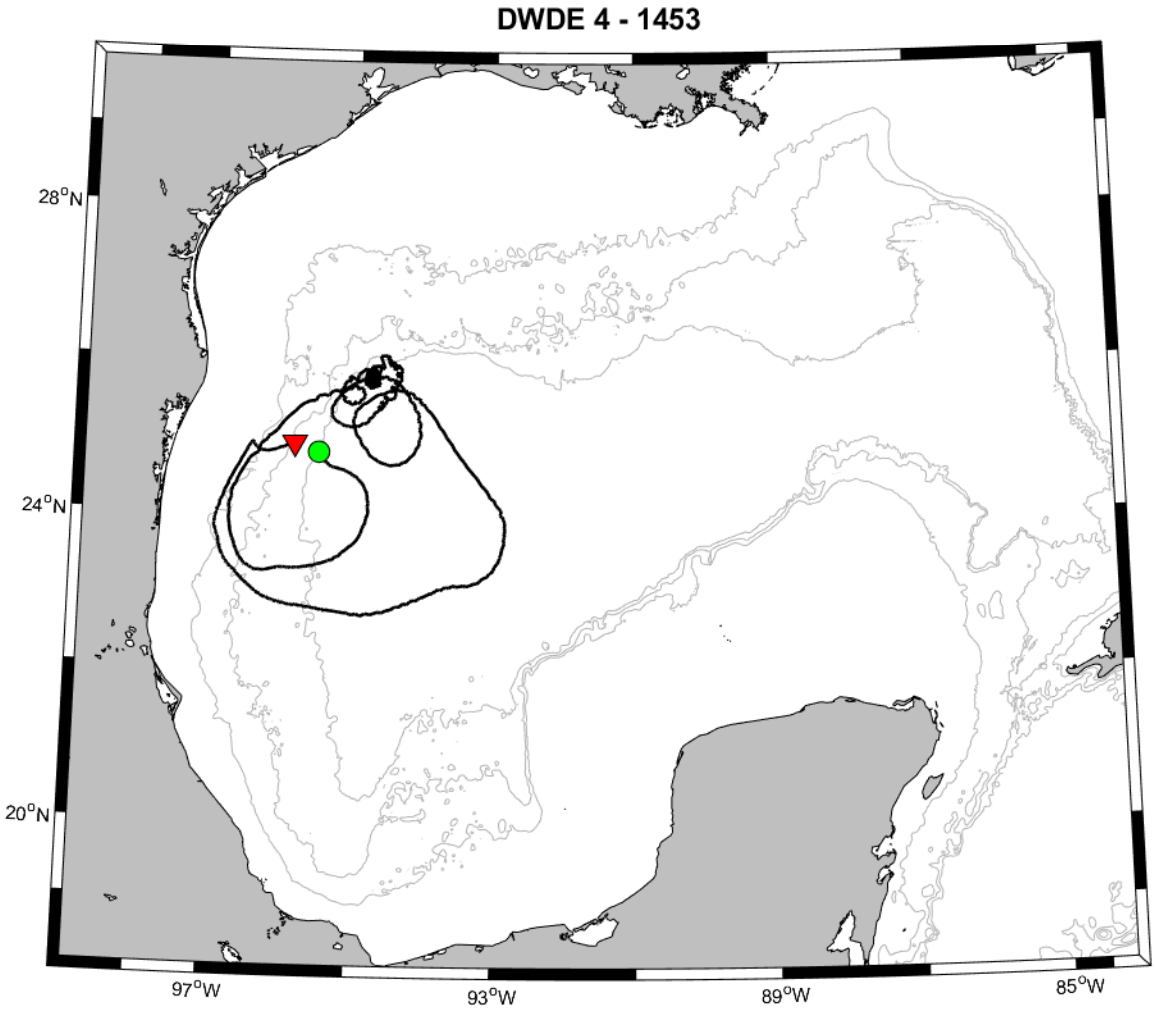

Float 1451 DWDE 1 (300-dbar)
temperature (℃)
14.9
12.9
10.9
pressure (db)
226
326
426
u-velocity (cm/s)
50
0
-50
v-velocity (cm/s)
50
0
-50
u-v velocity (cm/s)
50
0
-50
Jul 2016
Sep 2016
Nov 2016
Jan 2017
Mar 2017
May 2017
Jul 2017
Sep 2017
Nov 2017

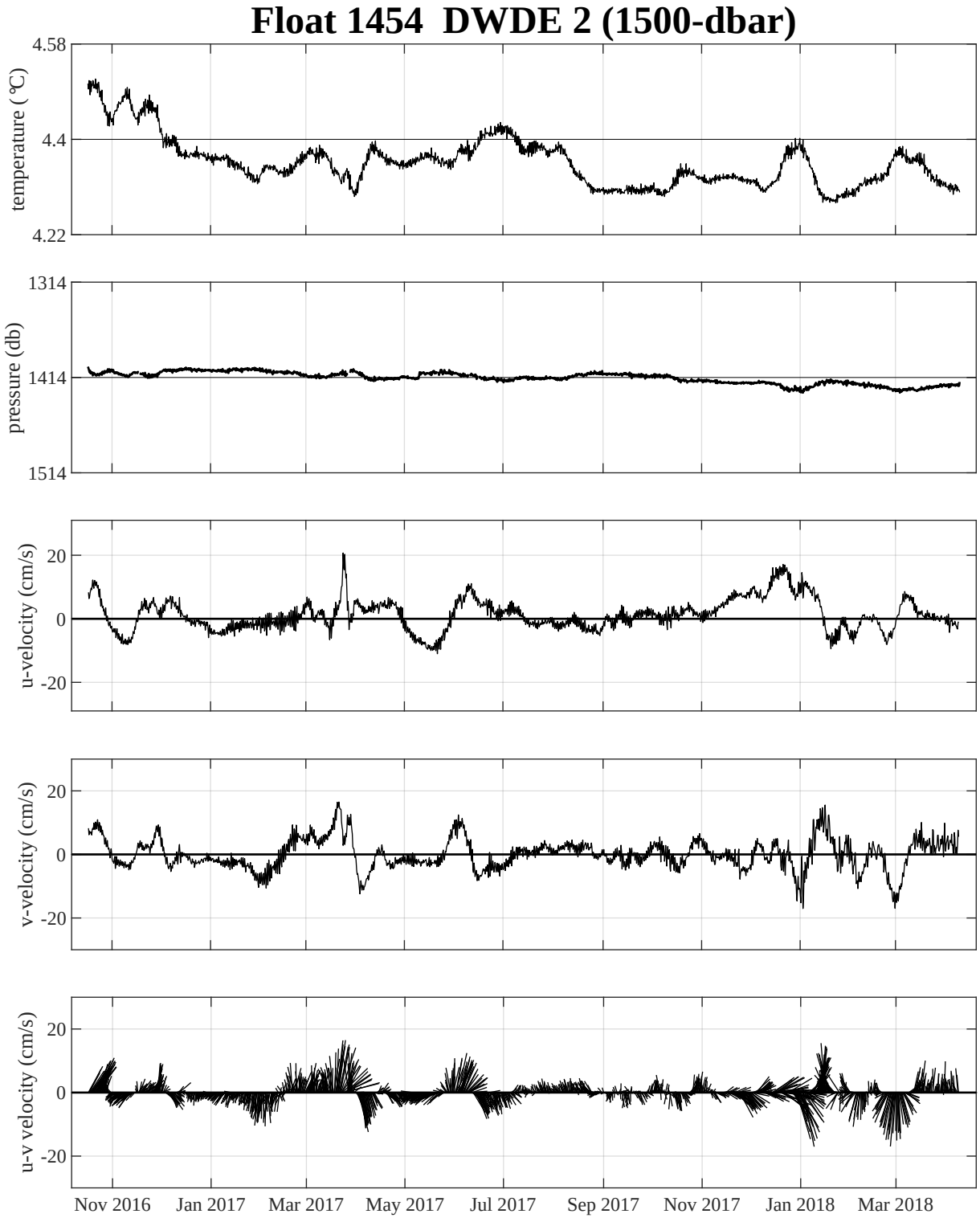

DWDE 1 - 1451
28°N
24°N
20°N
97°W
93°W
89°W
85°W

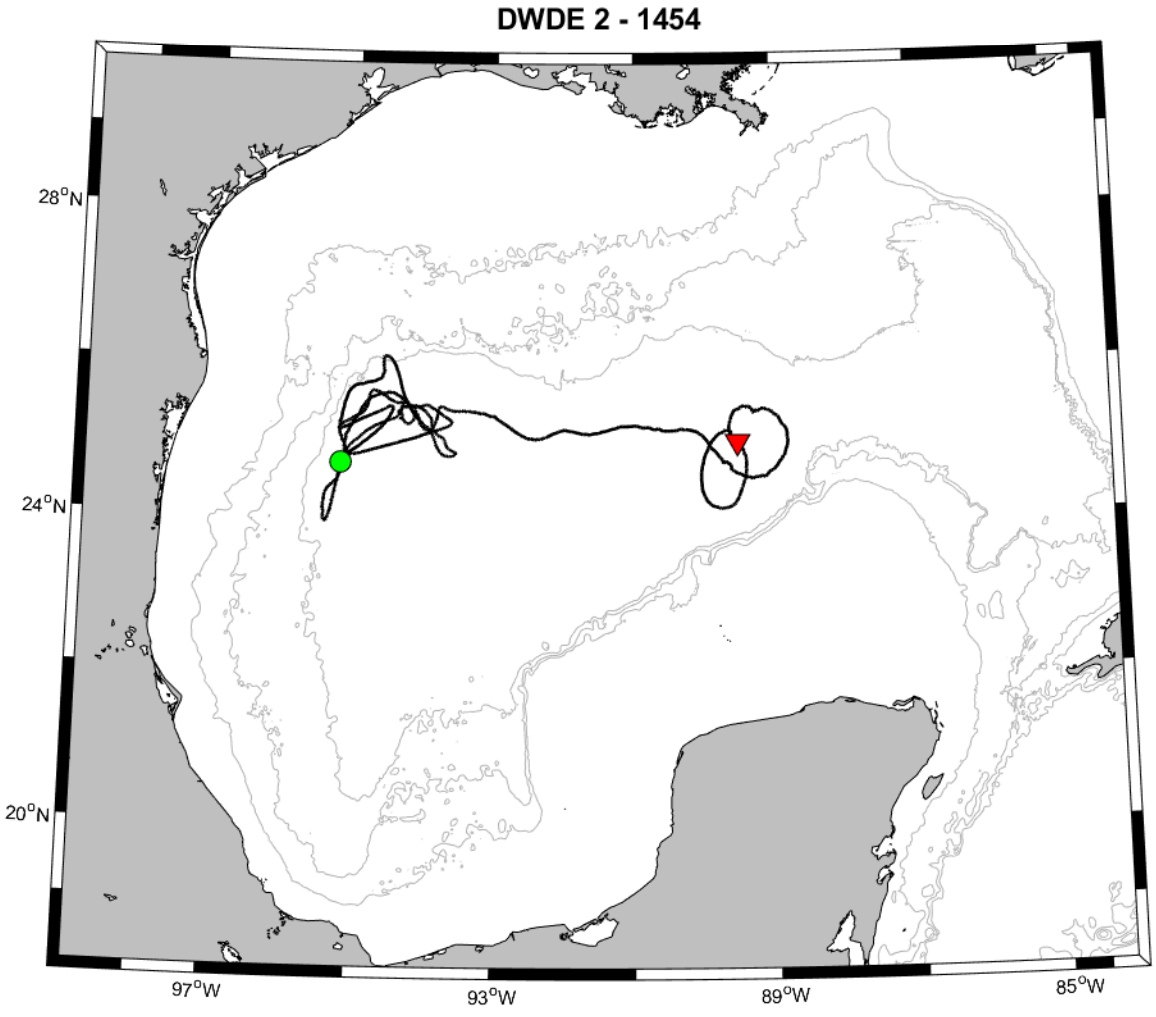

Float 1452 DWDE 4 (300-dbar)
temperature (℃)
14.8
12.8
10.8
pressure (db)
221
321
421
u-velocity (cm/s)
50
0
-50
v-velocity (cm/s)
50
0
-50
u-v velocity (cm/s)
50
0
-50
Nov 2017
Jan 2018
Mar 2018
May 2018
Jul 2018
Sep 2018
Nov 2018

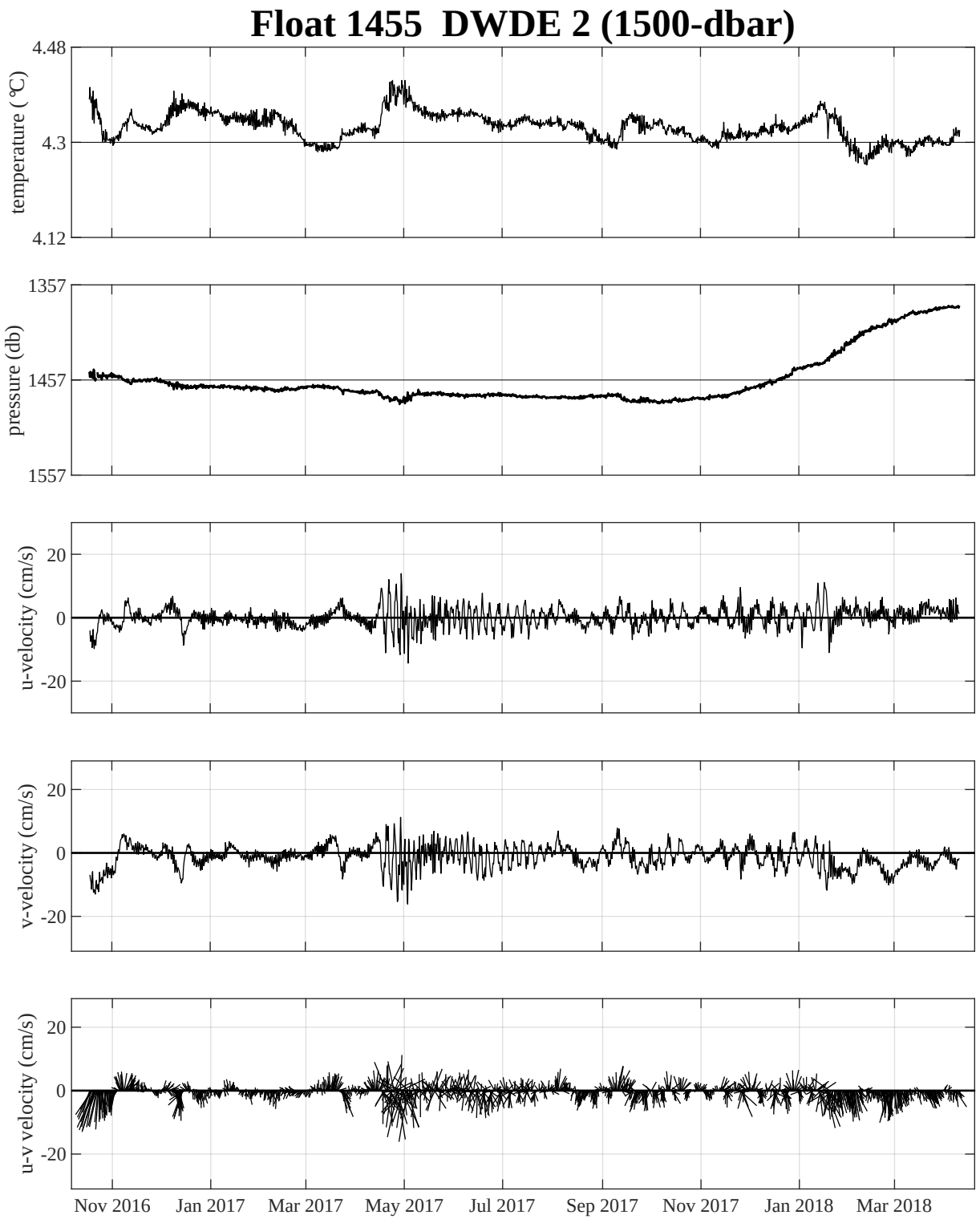

DWDE 4 - 1452
28°N
24°N
20°N
97°W
93°W
89°W
85°W

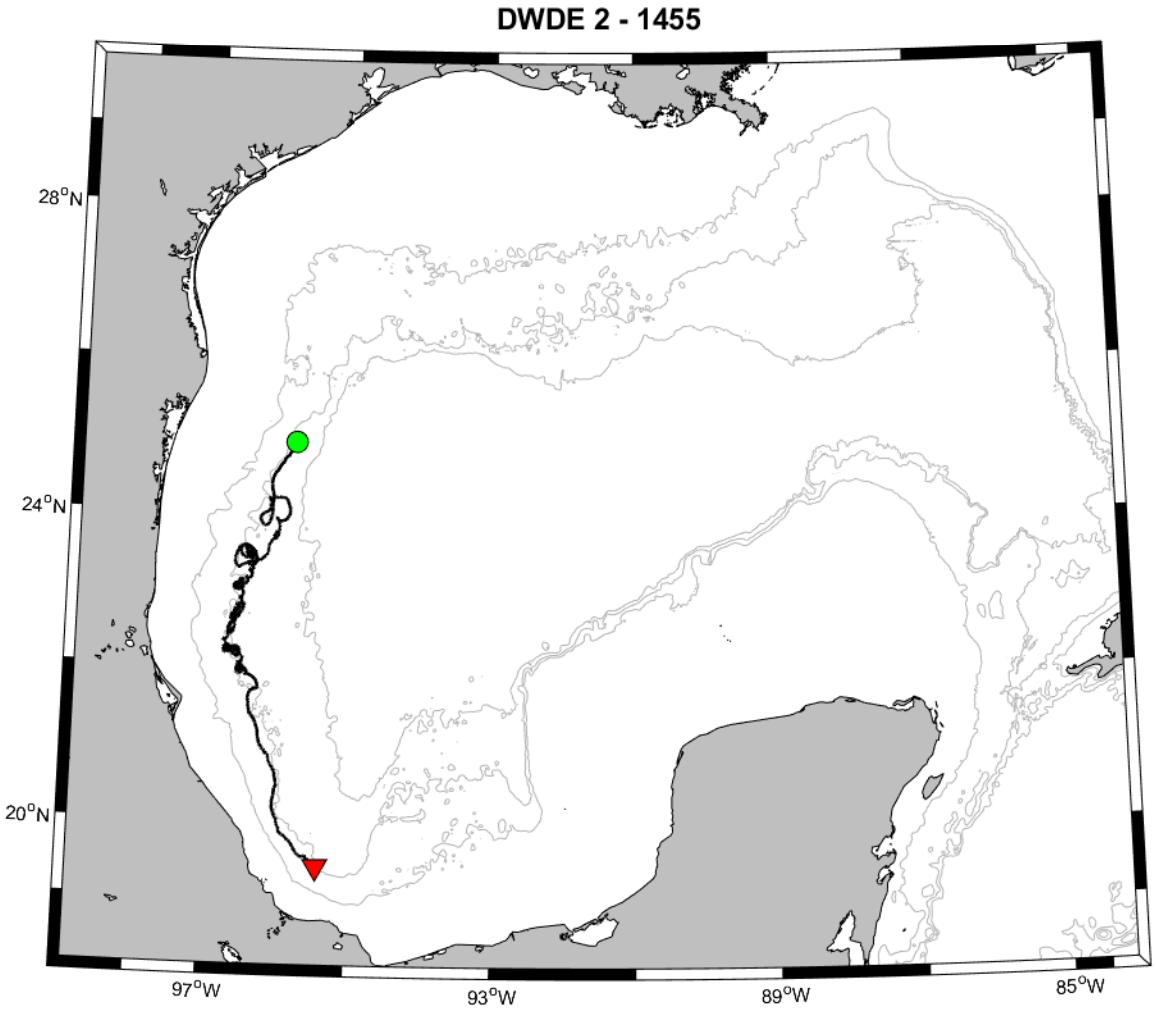

Float 1453 DWDE 4 (300-dbar)
temperature (℃)
14.3
12.3
10.3
pressure (db)
259
359
459
u-velocity (cm/s)
50
0
-50
v-velocity (cm/s)
50
0
-50
u-v velocity (cm/s)
50
0
-50
Nov 2017
Jan 2018
Mar 2018
May 2018
Jul 2018
Sep 2018
Nov 2018

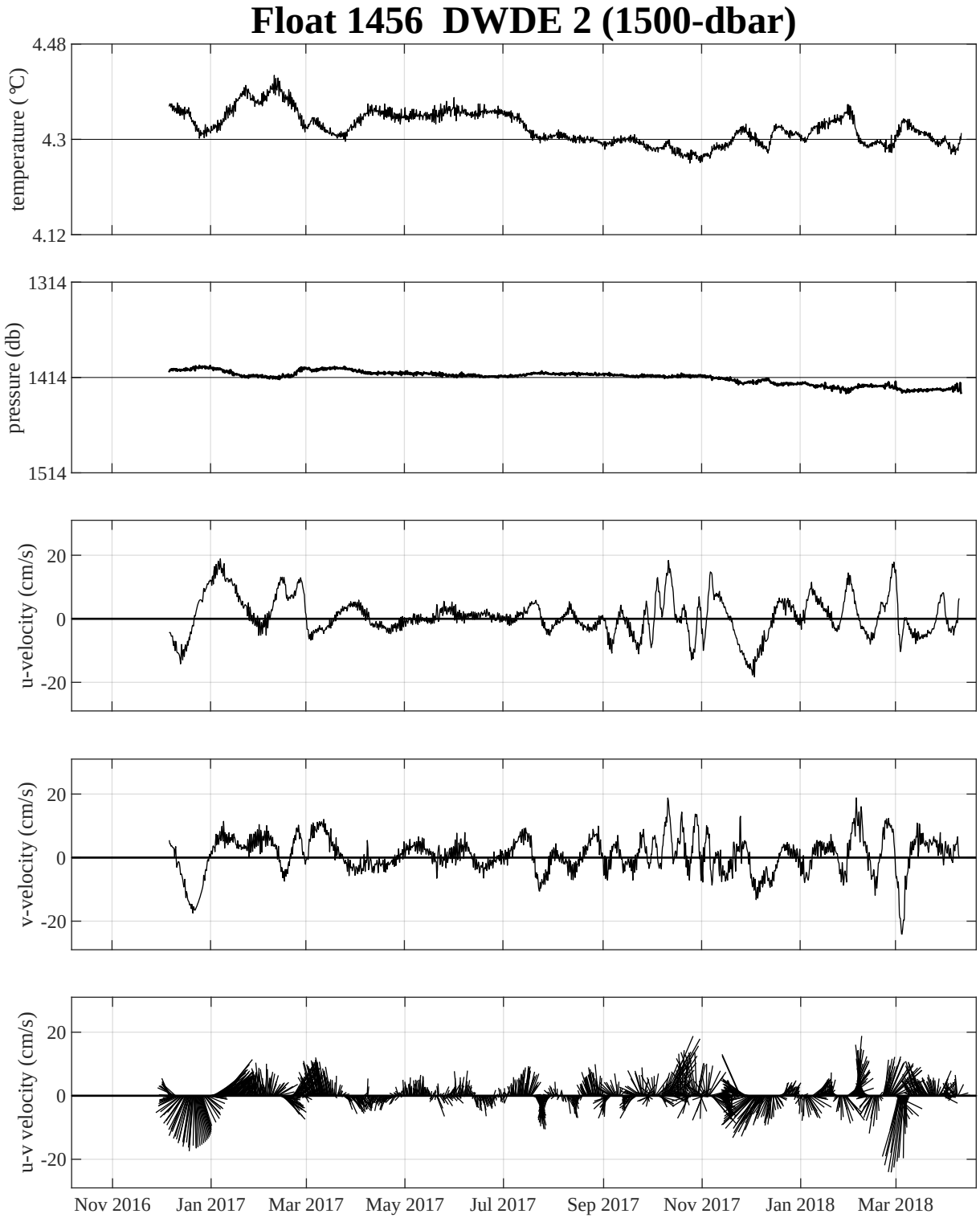

DWDE 4 - 1453
28°N
24°N
20°N
97°W
93°W
89°W
85°W

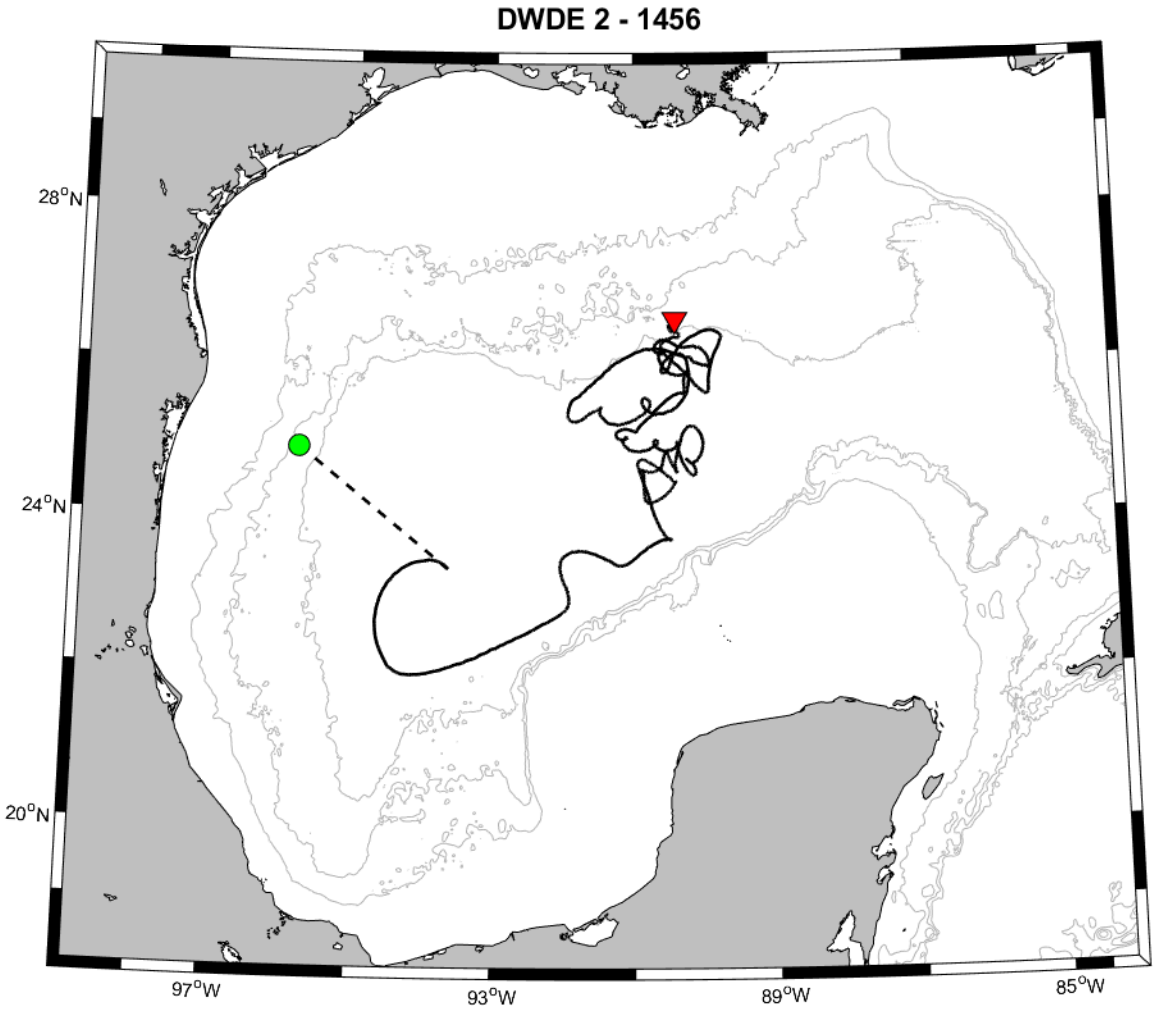

Float 1454 DWDE 2 (1500-dbar)
temperature (℃)
4.58
4.4
4.22
pressure (db)
1314
1414
1514
u-velocity (cm/s)
20
0
-20
v-velocity (cm/s)
20
0
-20
u-v velocity (cm/s)
20
0
-20
Nov 2016
Jan 2017
Mar 2017
May 2017
Jul 2017
Sep 2017
Nov 2017
Jan 2018
Mar 2018

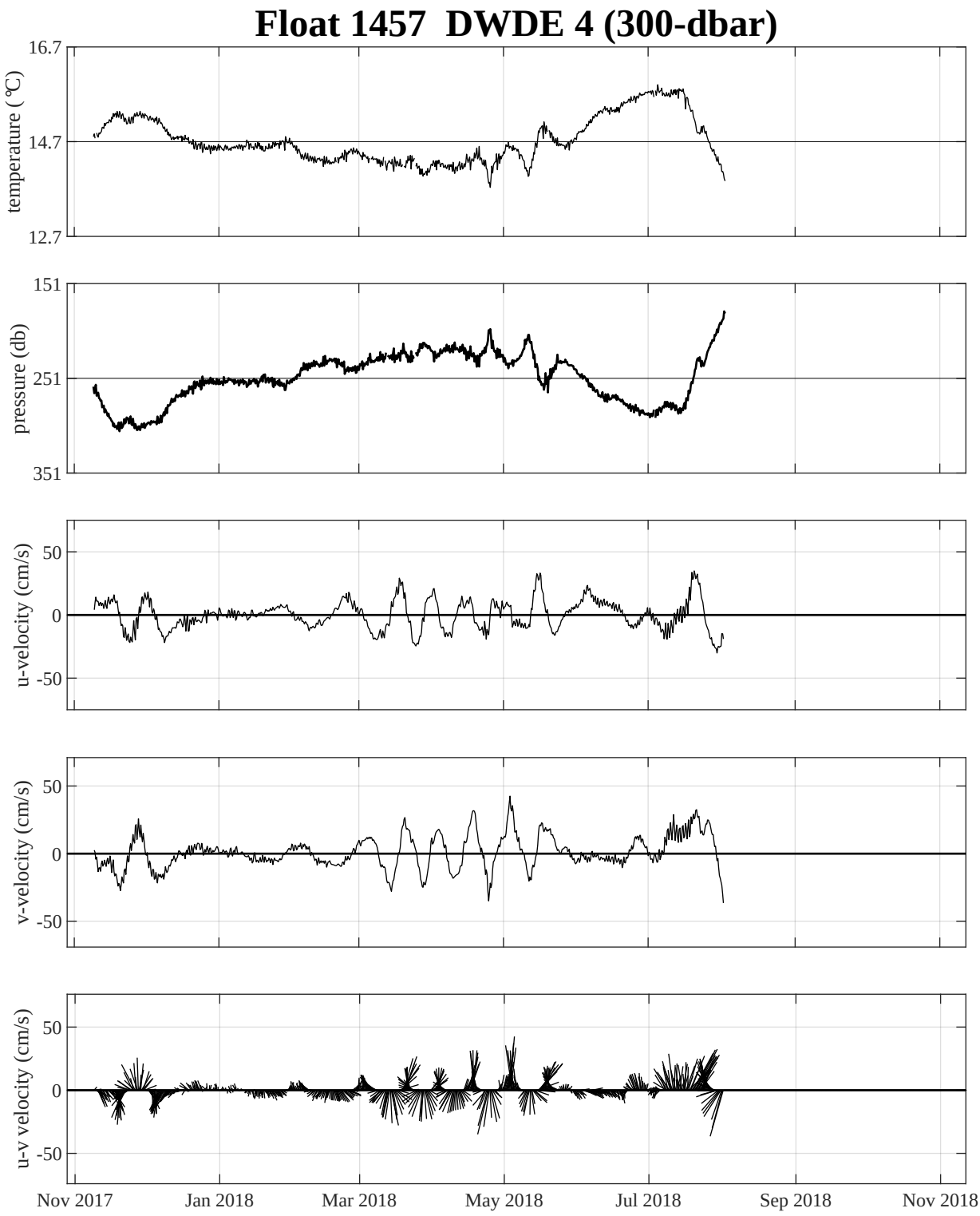

DWDE 2 - 1454
28°N
24°N
20°N
97°W
93°W
89°W
85°W

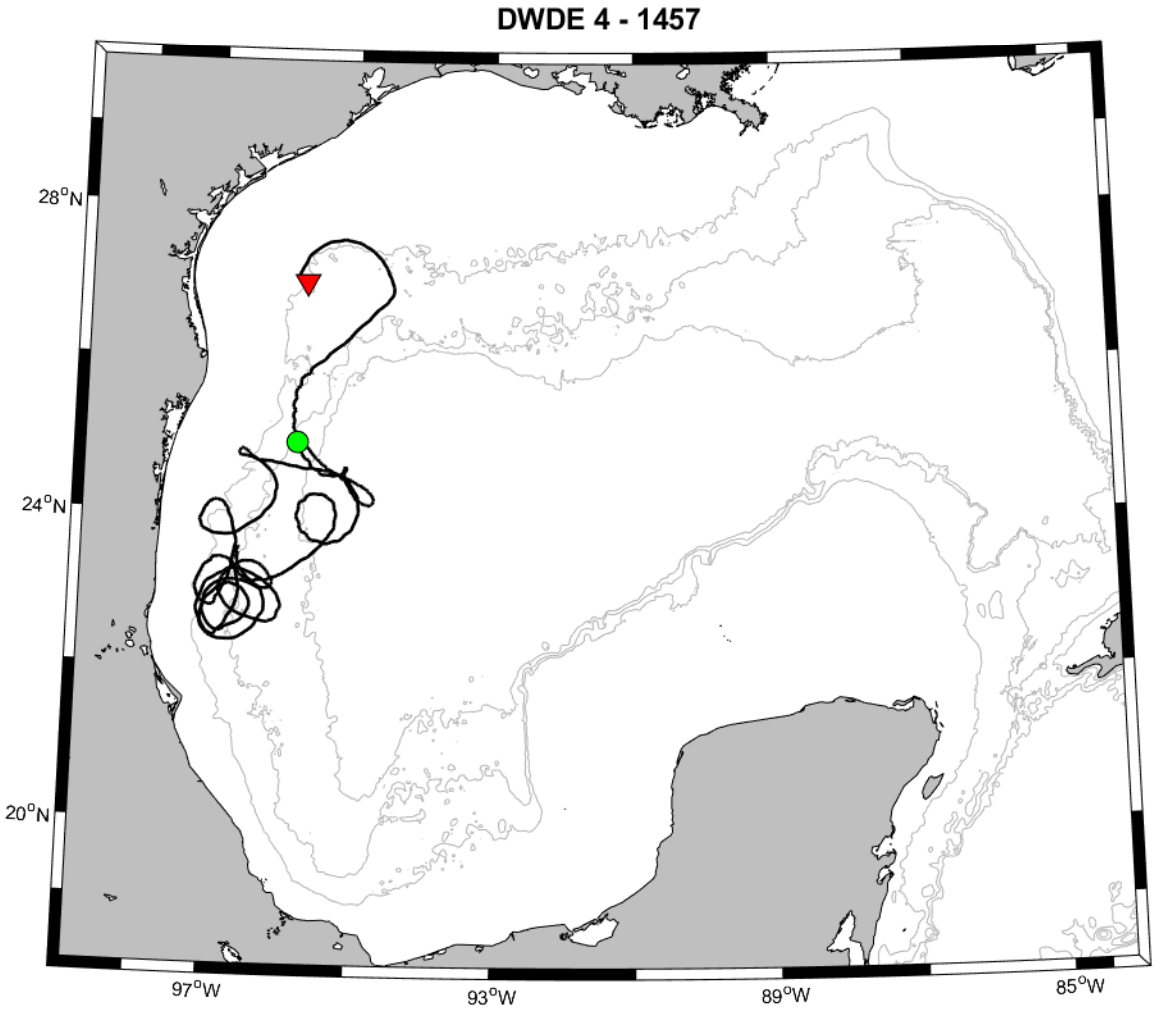

Float 1455 DWDE 2 (1500-dbar)
temperature (℃)
4.48
4.3
4.12
pressure (db)
1357
1457
1557
u-velocity (cm/s)
20
0
-20
v-velocity (cm/s)
20
0
-20
u-v velocity (cm/s)
20
0
-20
Nov 2016
Jan 2017
Mar 2017
May 2017
Jul 2017
Sep 2017
Nov 2017
Jan 2018
Mar 2018

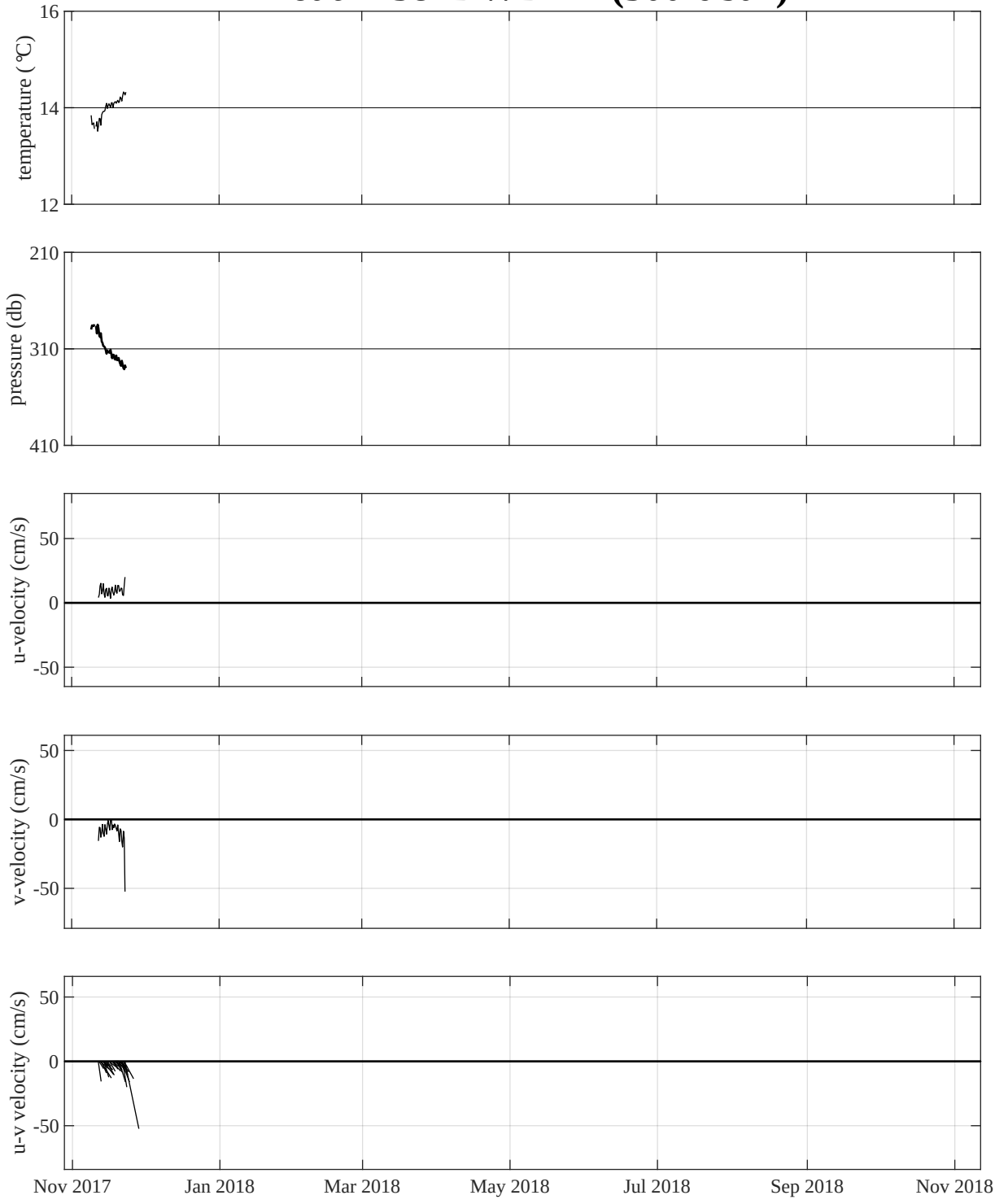

DWDE 2 - 1455
28°N
24°N
20°N
97°W
93°W
89°W
85°W

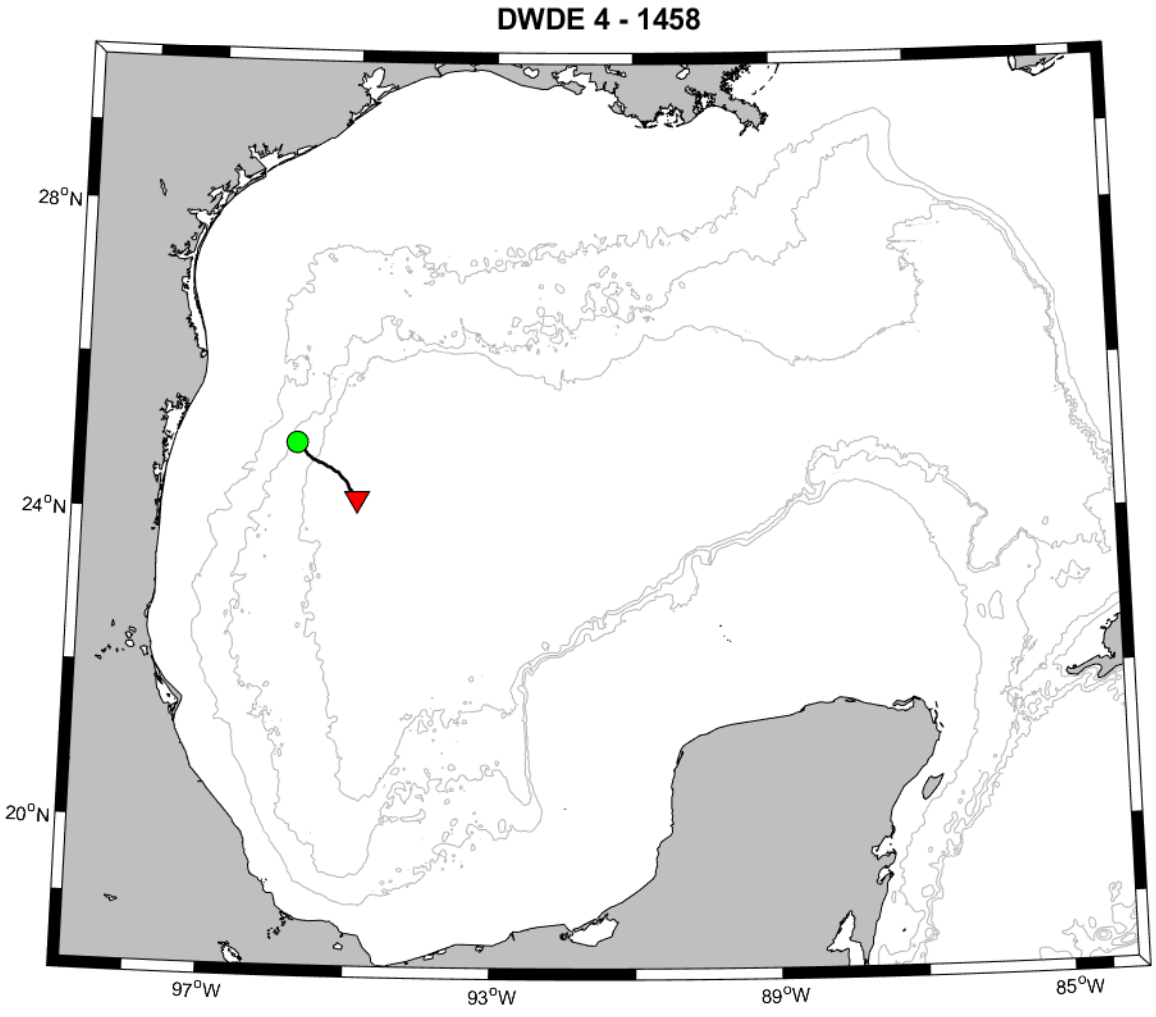

Float 1456 DWDE 2 (1500-dbar)
temperature (℃)
4.48
4.3
4.12
pressure (db)
1314
1414
1514
u-velocity (cm/s)
20
0
-20
v-velocity (cm/s)
20
0
-20
u-v velocity (cm/s)
20
0
-20
Nov 2016
Jan 2017
Mar 2017
May 2017
Jul 2017
Sep 2017
Nov 2017
Jan 2018
Mar 2018

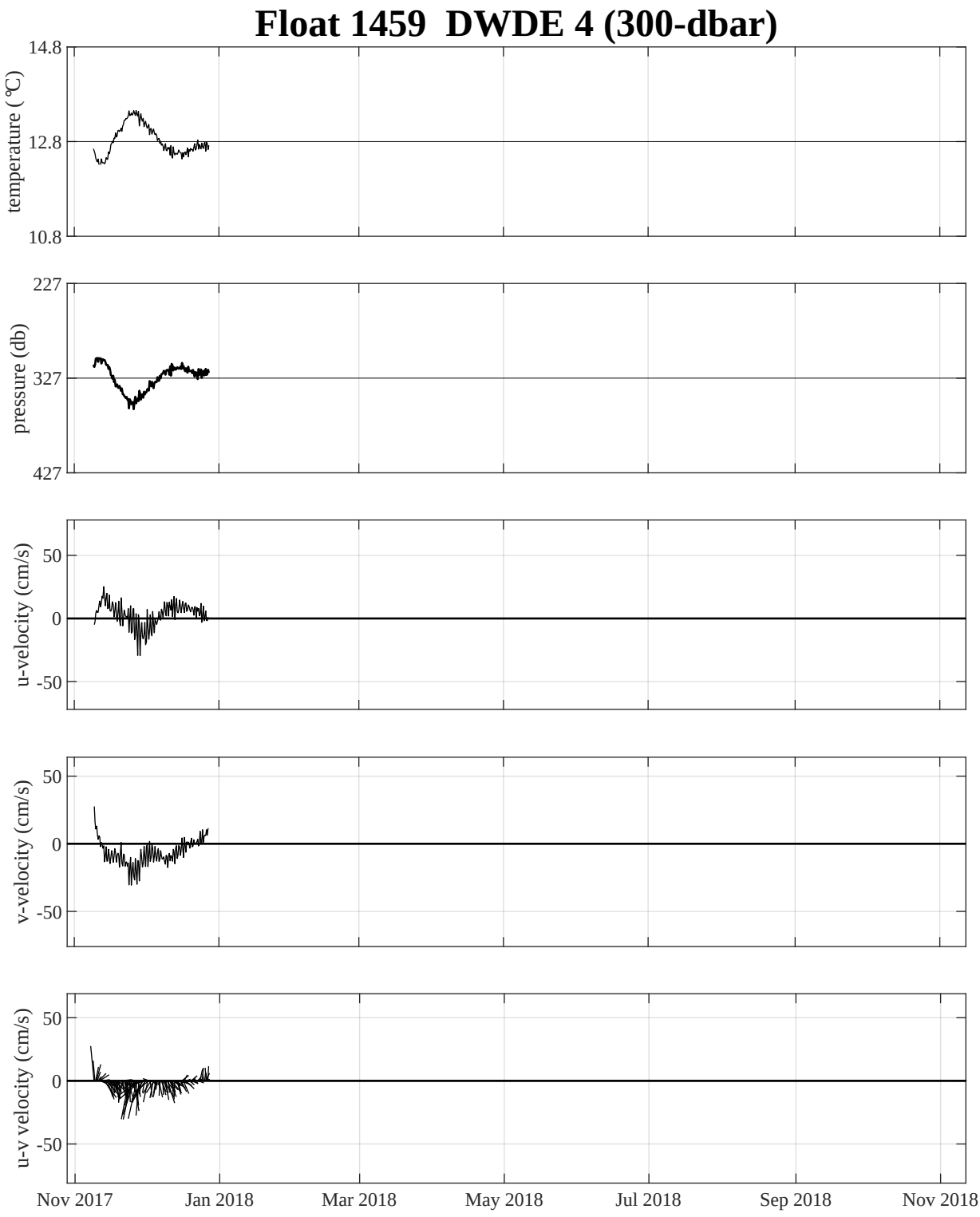

DWDE 2 - 1456
28°N
24°N
20°N
97°W
93°W
89°W
85°W

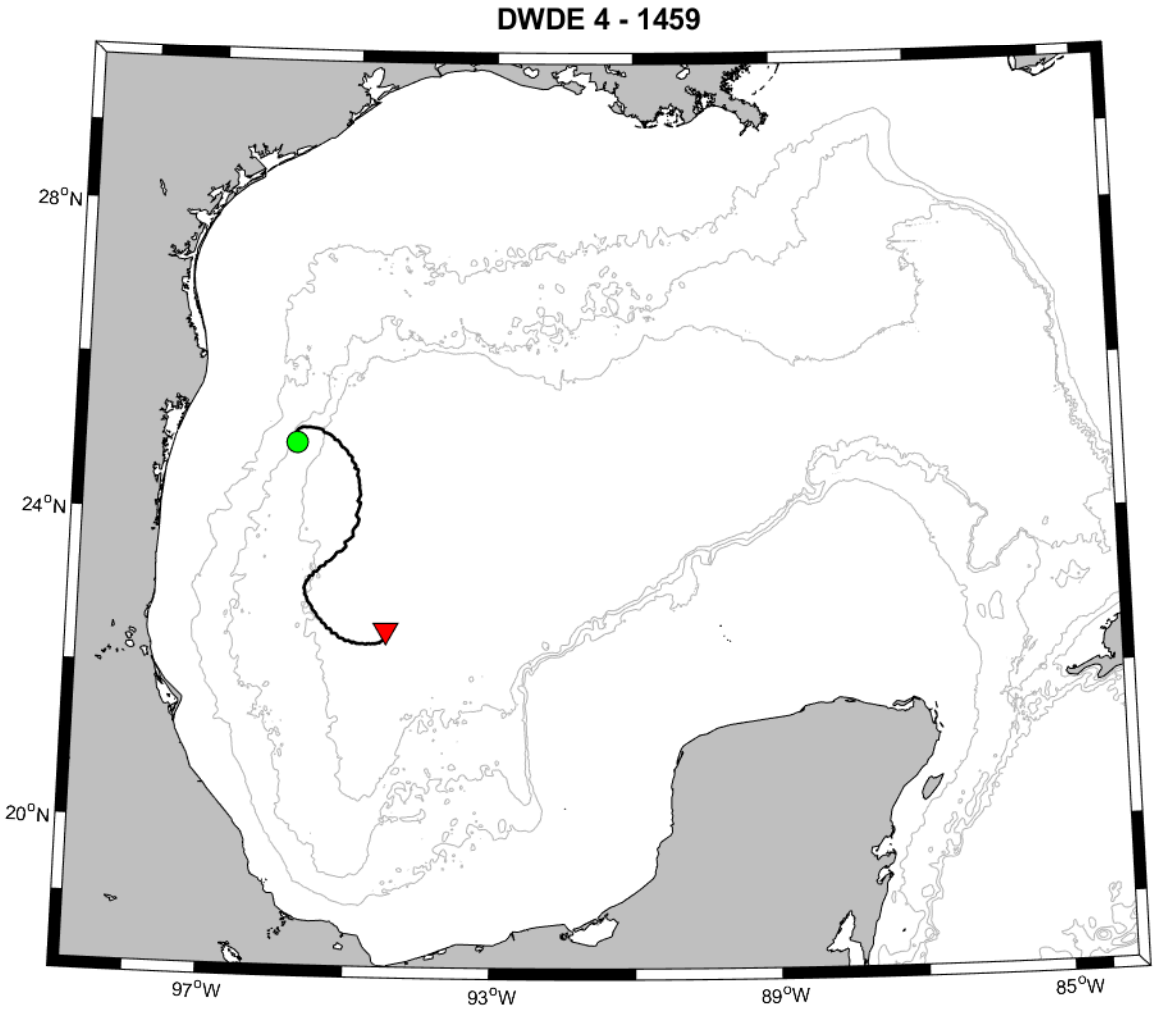

Float 1457 DWDE 4 (300-dbar)
temperature (℃)
16.7
14.7
12.7
pressure (db)
151
251
351
u-velocity (cm/s)
50
0
-50
v-velocity (cm/s)
50
0
-50
u-v velocity (cm/s)
50
0
-50
Nov 2017
Jan 2018
Mar 2018
May 2018
Jul 2018
Sep 2018
Nov 2018

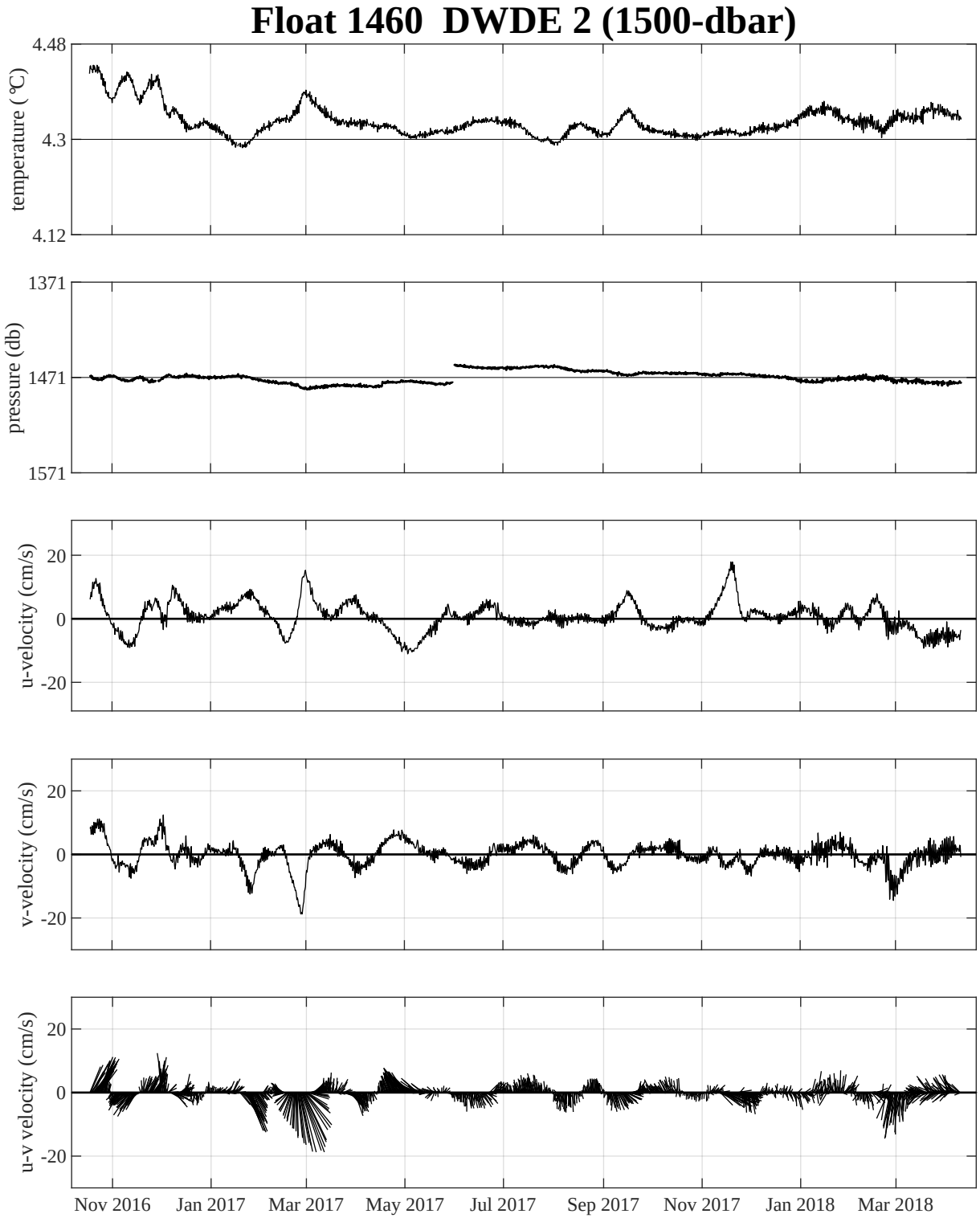

DWDE 4 - 1457
28°N
24°N
20°N
97°W
93°W
89°W
85°W

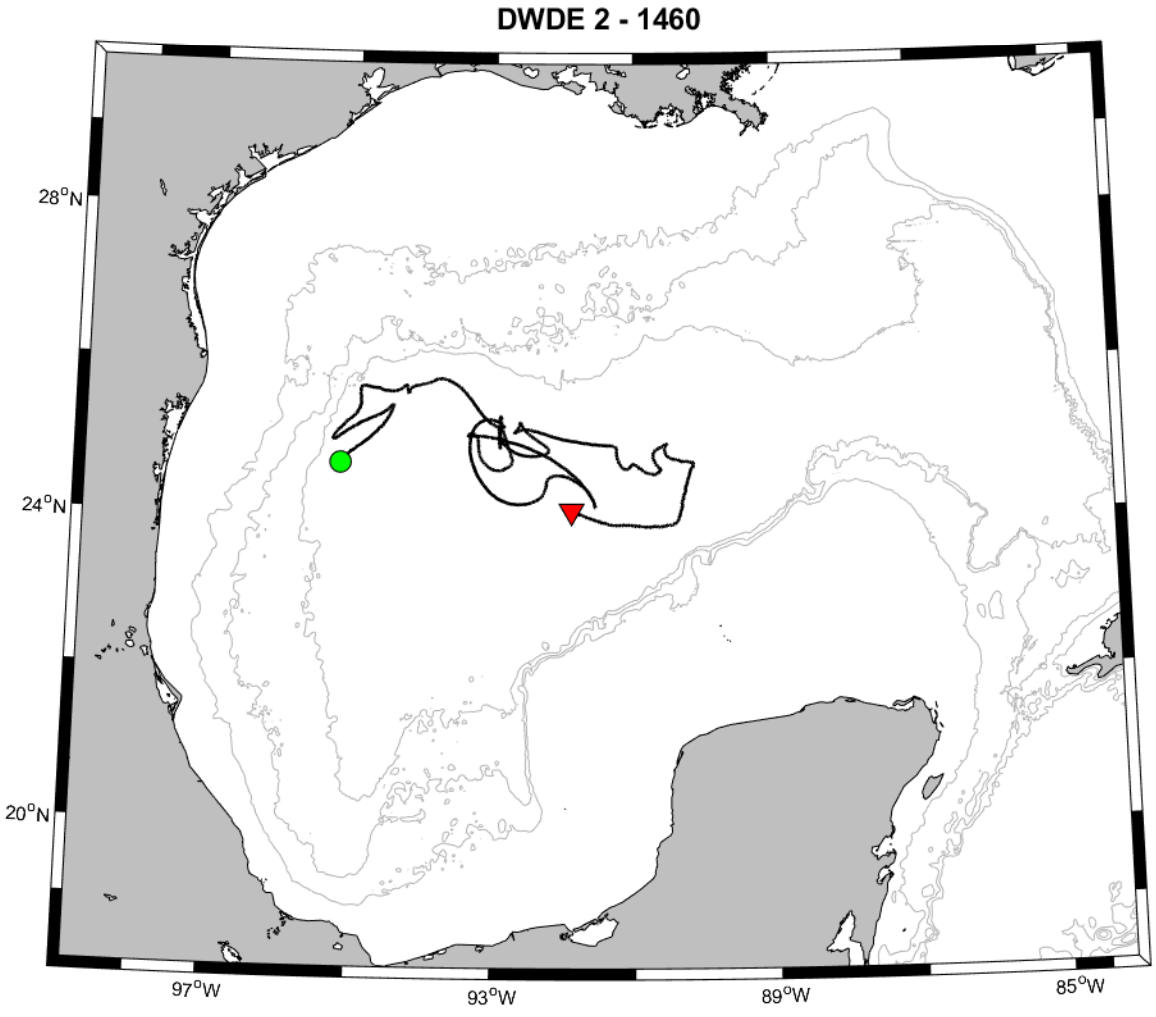

Float 1458 DWDE 4 (300-dbar)
temperature (°C)
16
14
12
pressure (db)
210
310
410
u-velocity (cm/s)
50
0
-50
v-velocity (cm/s)
50
0
-50
u-v velocity (cm/s)
50
0
-50
Nov 2017
Jan 2018
Mar 2018
May 2018
Jul 2018
Sep 2018
Nov 2018

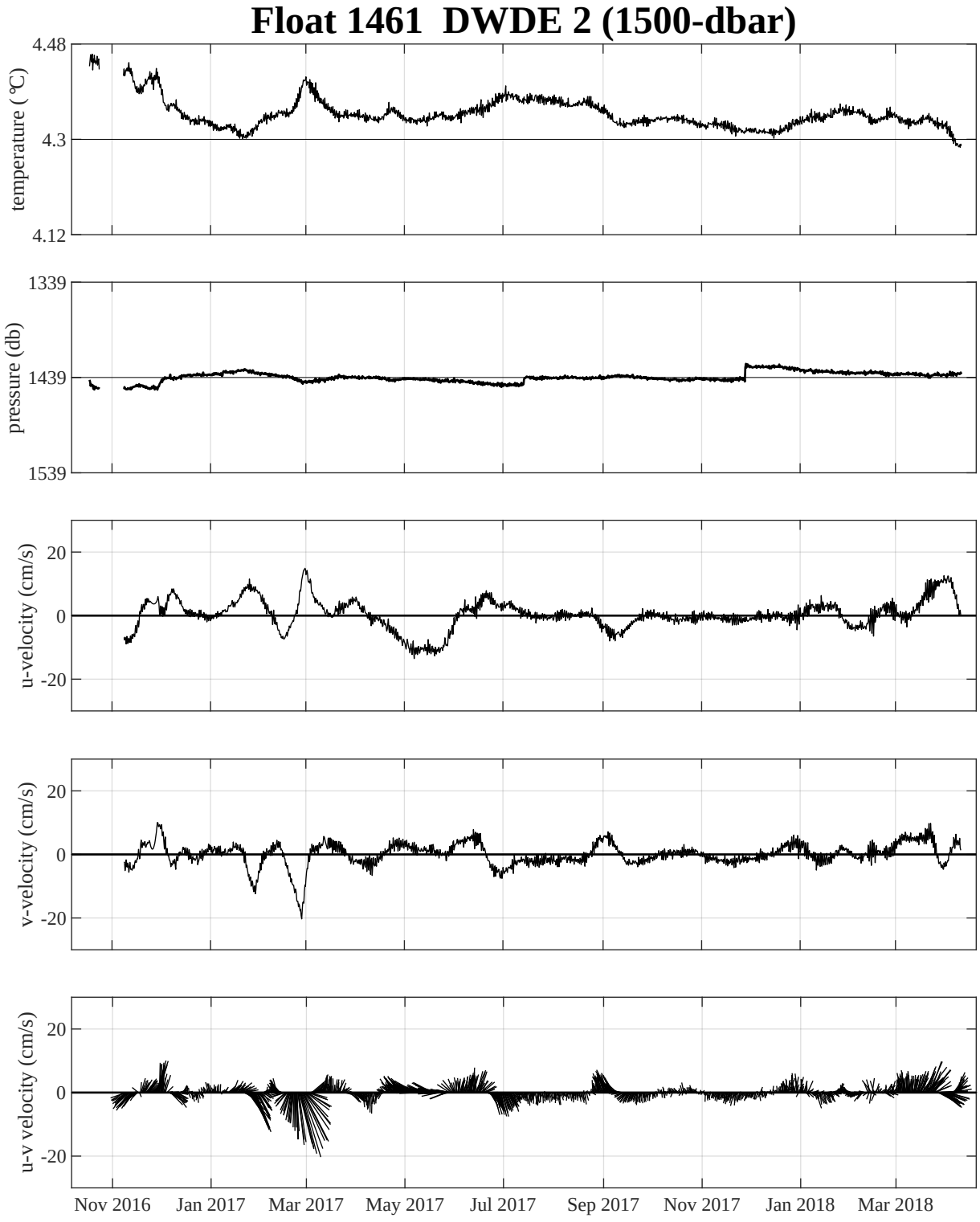

DWDE 4 - 1458
28°N
24°N
20°N
97°W
93°W
89°W
85°W

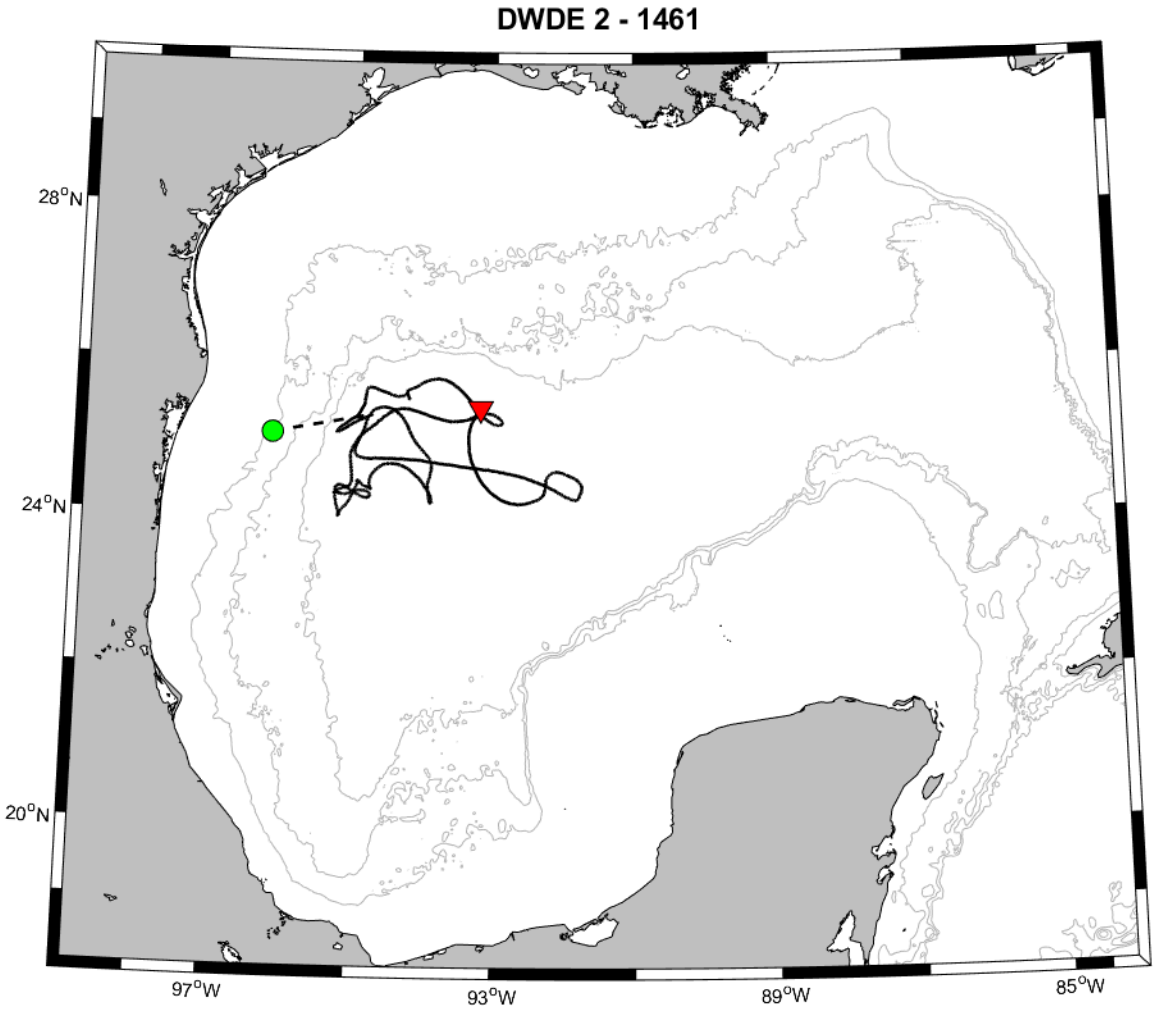

Float 1459 DWDE 4 (300-dbar)
temperature (℃)
14.8
12.8
10.8
pressure (db)
227
327
427
u-velocity (cm/s)
50
0
-50
v-velocity (cm/s)
50
0
-50
u-v velocity (cm/s)
50
0
-50
Nov 2017
Jan 2018
Mar 2018
May 2018
Jul 2018
Sep 2018
Nov 2018

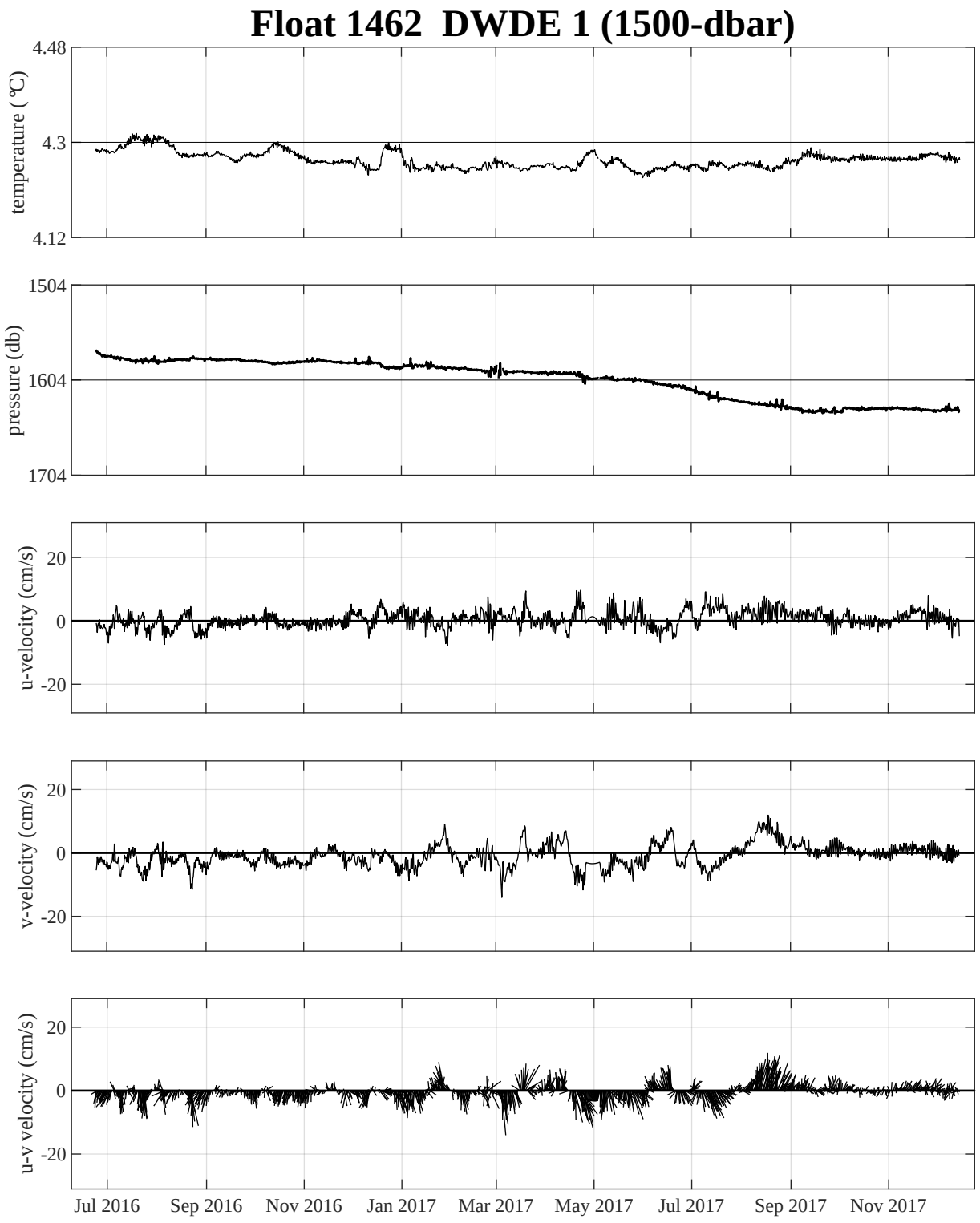

DWDE 4 - 1459
28°N
24°N
20°N
97°W
93°W
89°W
85°W

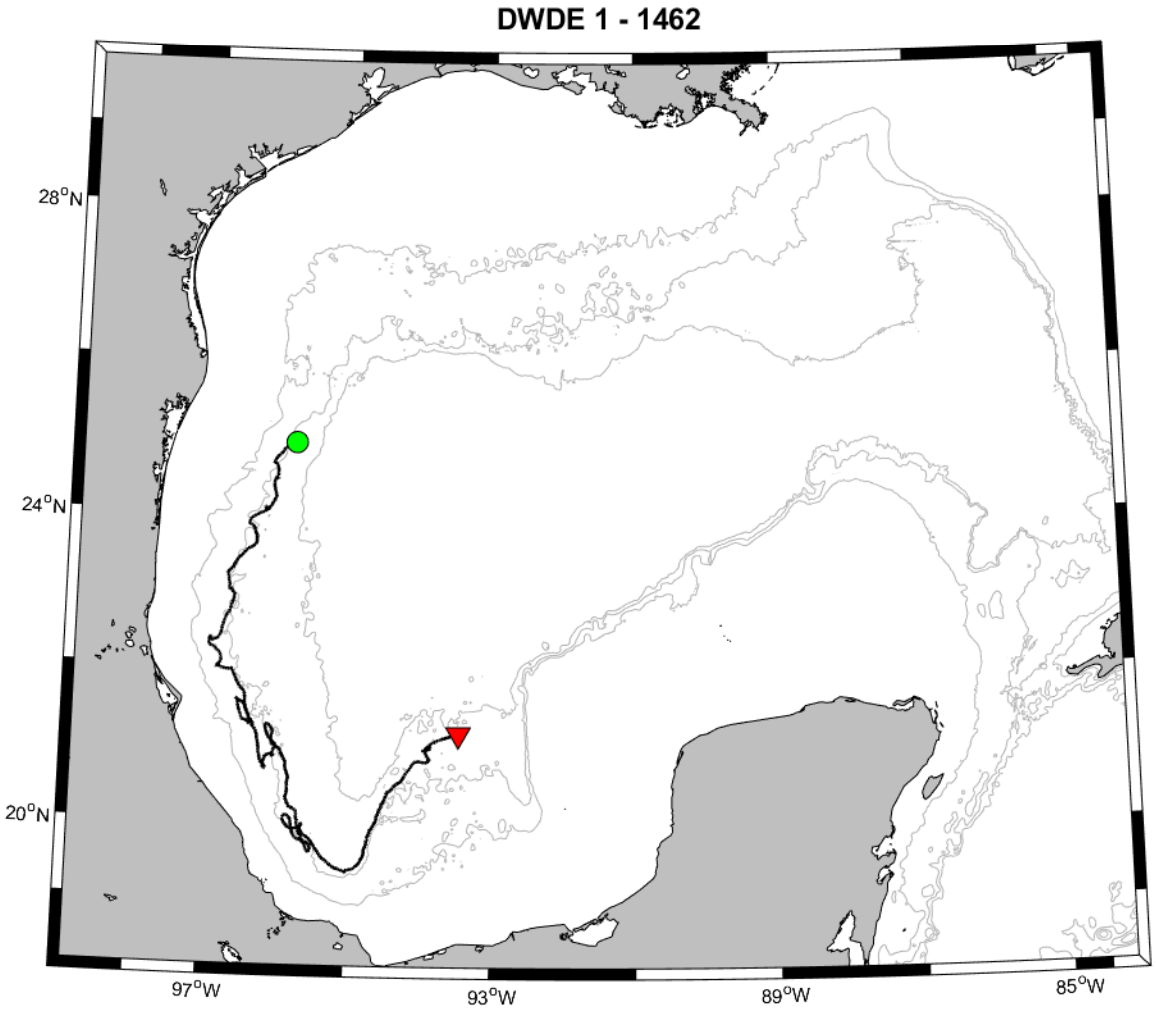

Float 1460 DWDE 2 (1500-dbar)
temperature (℃)
4.48
4.3
4.12
pressure (db)
1371
1471
1571
u-velocity (cm/s)
20
0
-20
v-velocity (cm/s)
20
0
-20
u-v velocity (cm/s)
20
0
-20
Nov 2016
Jan 2017
Mar 2017
May 2017
Jul 2017
Sep 2017
Nov 2017
Jan 2018
Mar 2018

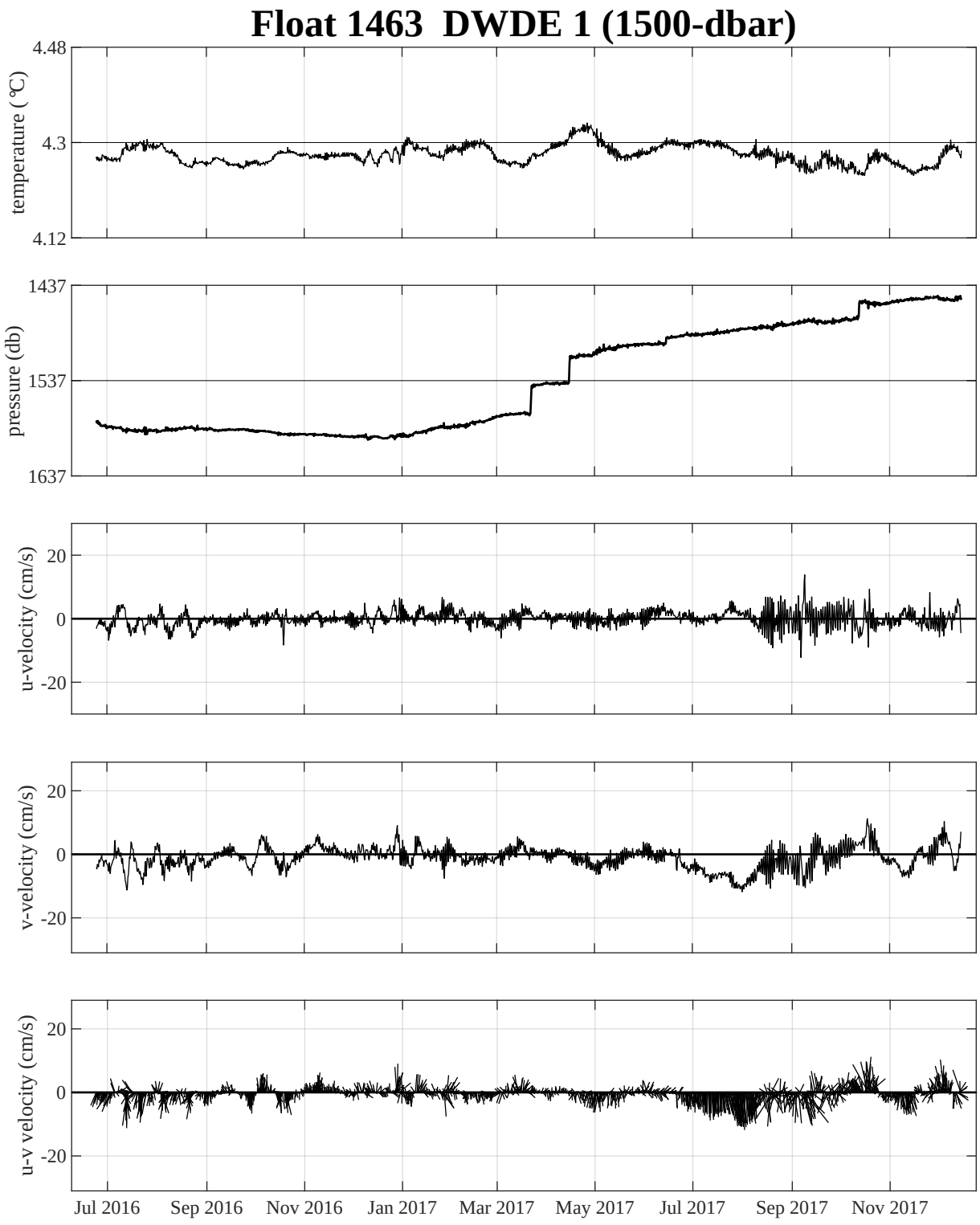

DWDE 2 - 1460
28°N
24°N
20°N
97°W
93°W
89°W
85°W

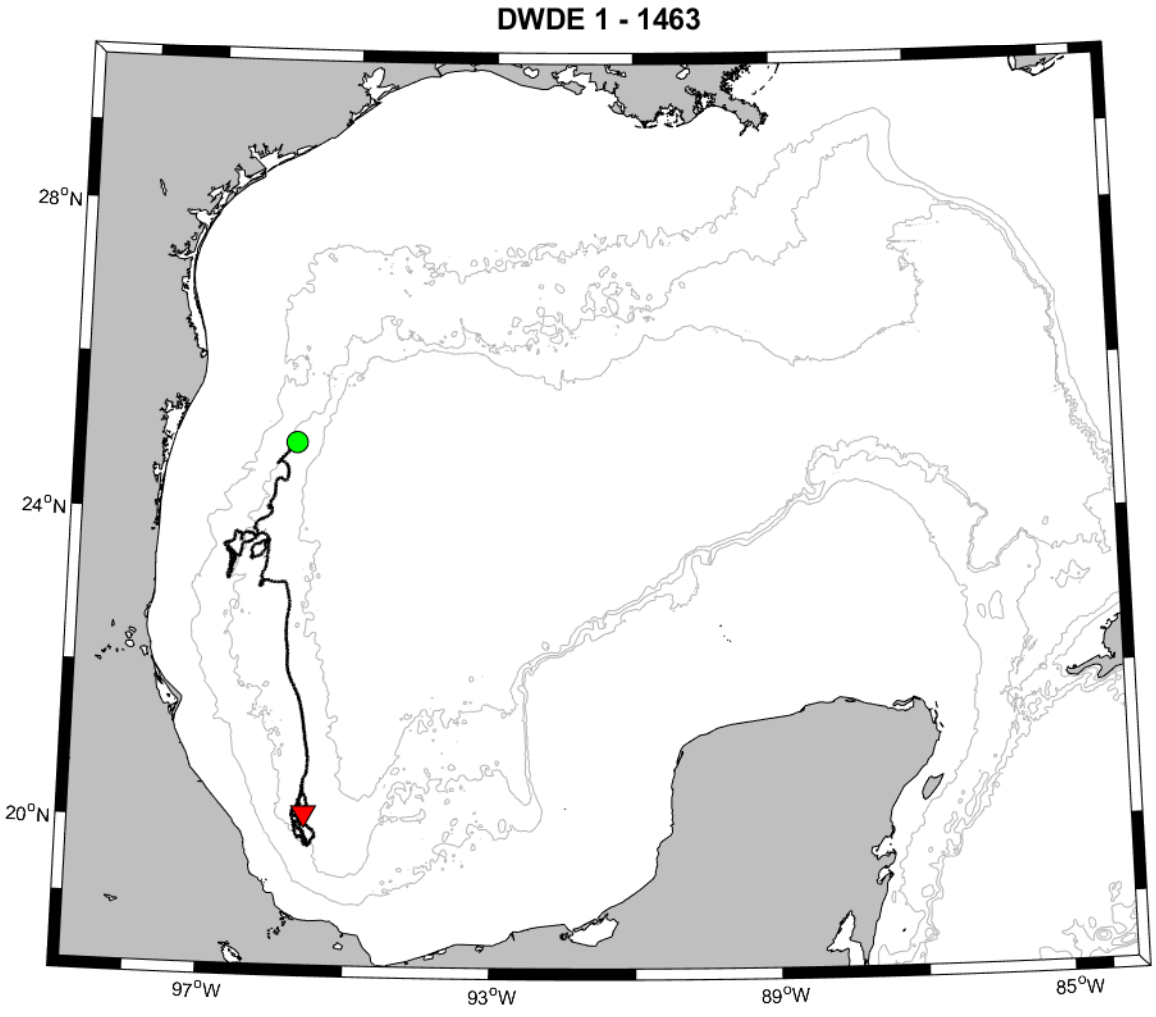

Float 1461 DWDE 2 (1500-dbar)
temperature (℃)
4.48
4.3
4.12
pressure (db)
1339
1439
1539
u-velocity (cm/s)
20
0
-20
v-velocity (cm/s)
20
0
-20
u-v velocity (cm/s)
20
0
-20
Nov 2016
Jan 2017
Mar 2017
May 2017
Jul 2017
Sep 2017
Nov 2017
Jan 2018
Mar 2018

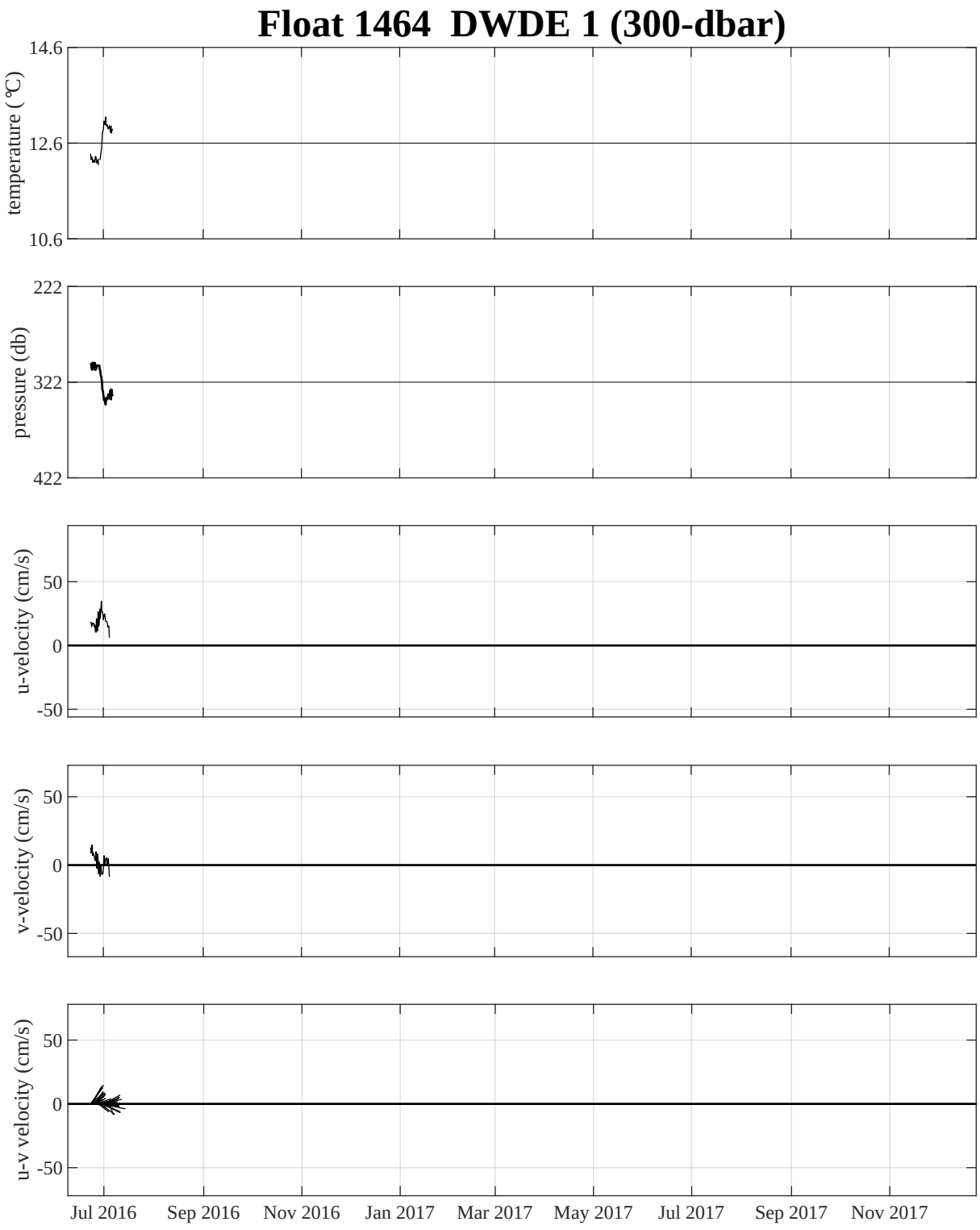

DWDE 2 - 1461
28°N
24°N
20°N
97°W
93°W
89°W
85°W

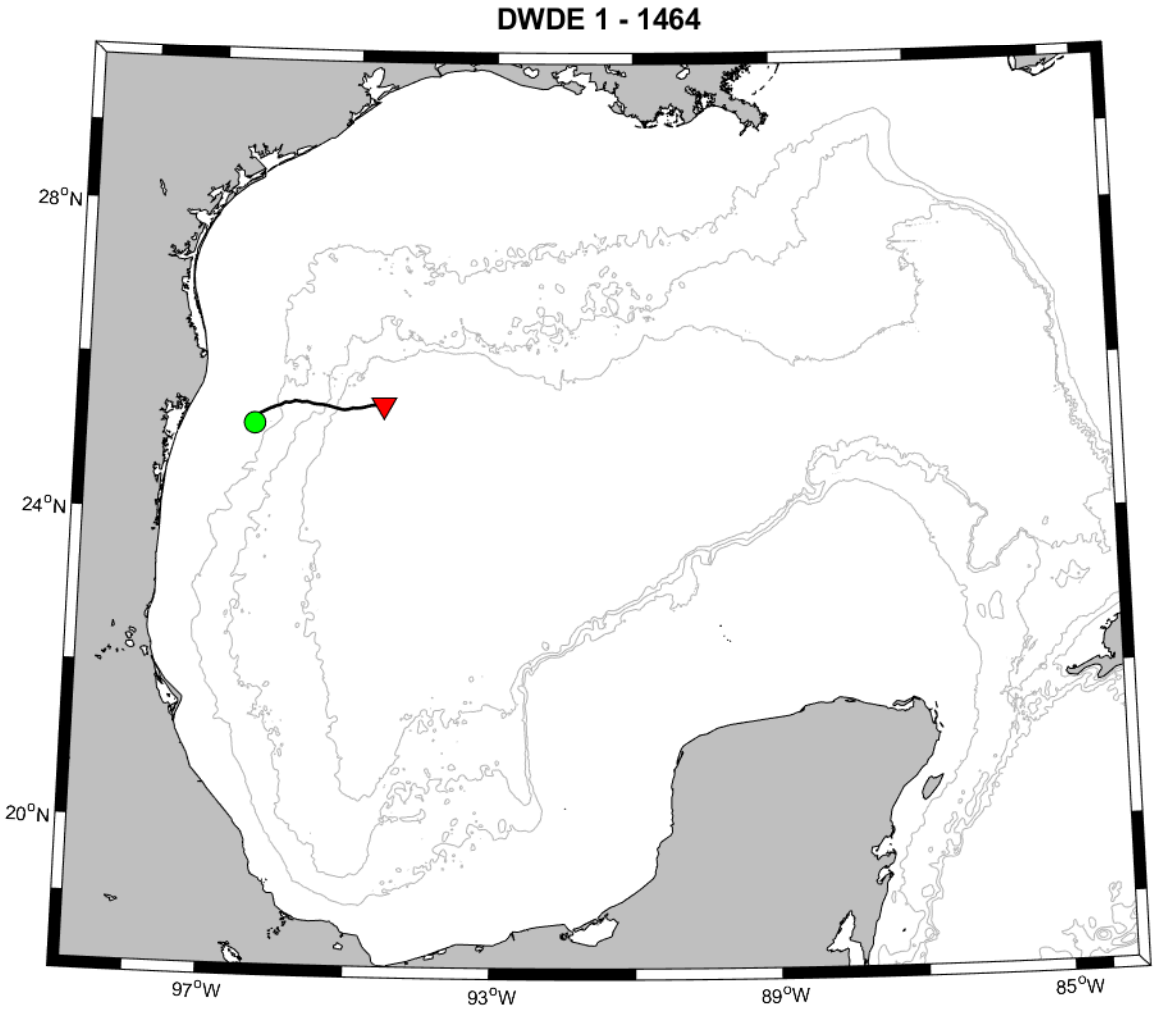

Float 1462 DWDE 1 (1500-dbar)
temperature (℃)
4.48
4.3
4.12
pressure (db)
1504
1604
1704
u-velocity (cm/s)
20
0
-20
v-velocity (cm/s)
20
0
-20
u-v velocity (cm/s)
20
0
-20
Jul 2016
Sep 2016
Nov 2016
Jan 2017
Mar 2017
May 2017
Jul 2017
Sep 2017
Nov 2017

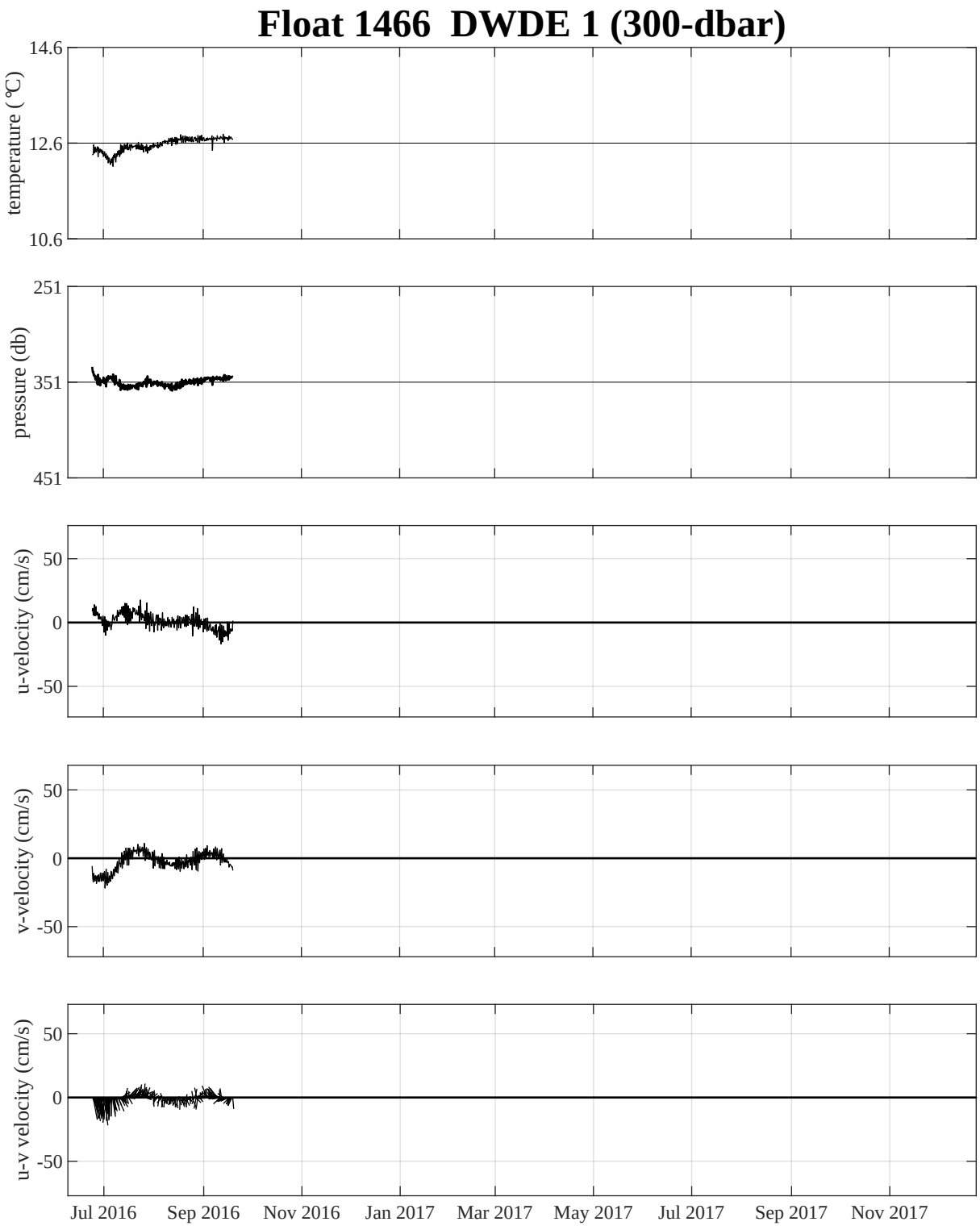

DWDE 1 - 1462
28°N
24°N
20°N
97°W
93°W
89°W
85°W

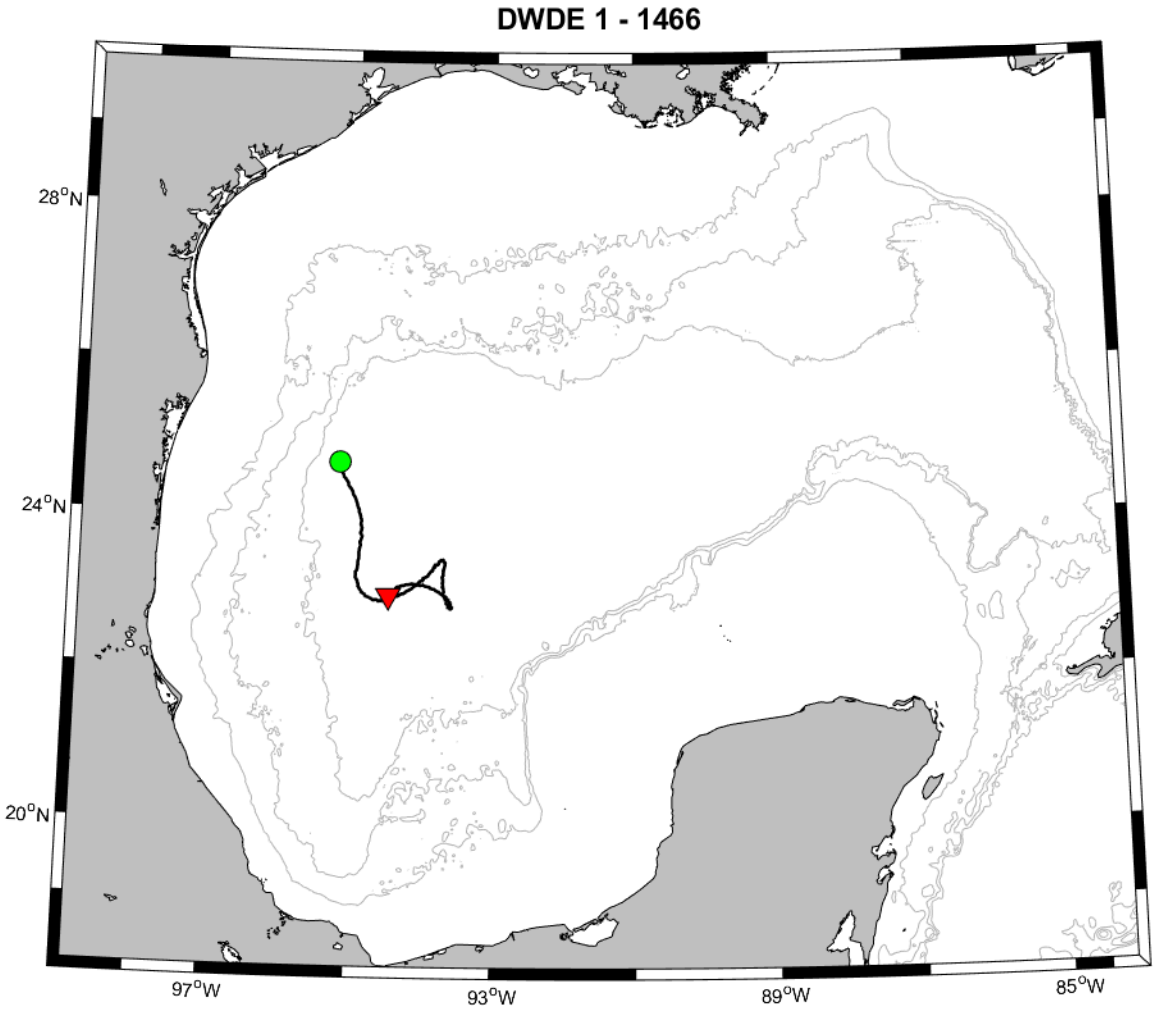

Float 1463 DWDE 1 (1500-dbar)
temperature (℃)
4.48
4.3
4.12
pressure (db)
1437
1537
1637
u-velocity (cm/s)
20
0
-20
v-velocity (cm/s)
20
0
-20
u-v velocity (cm/s)
20
0
-20
Jul 2016
Sep 2016
Nov 2016
Jan 2017
Mar 2017
May 2017
Jul 2017
Sep 2017
Nov 2017

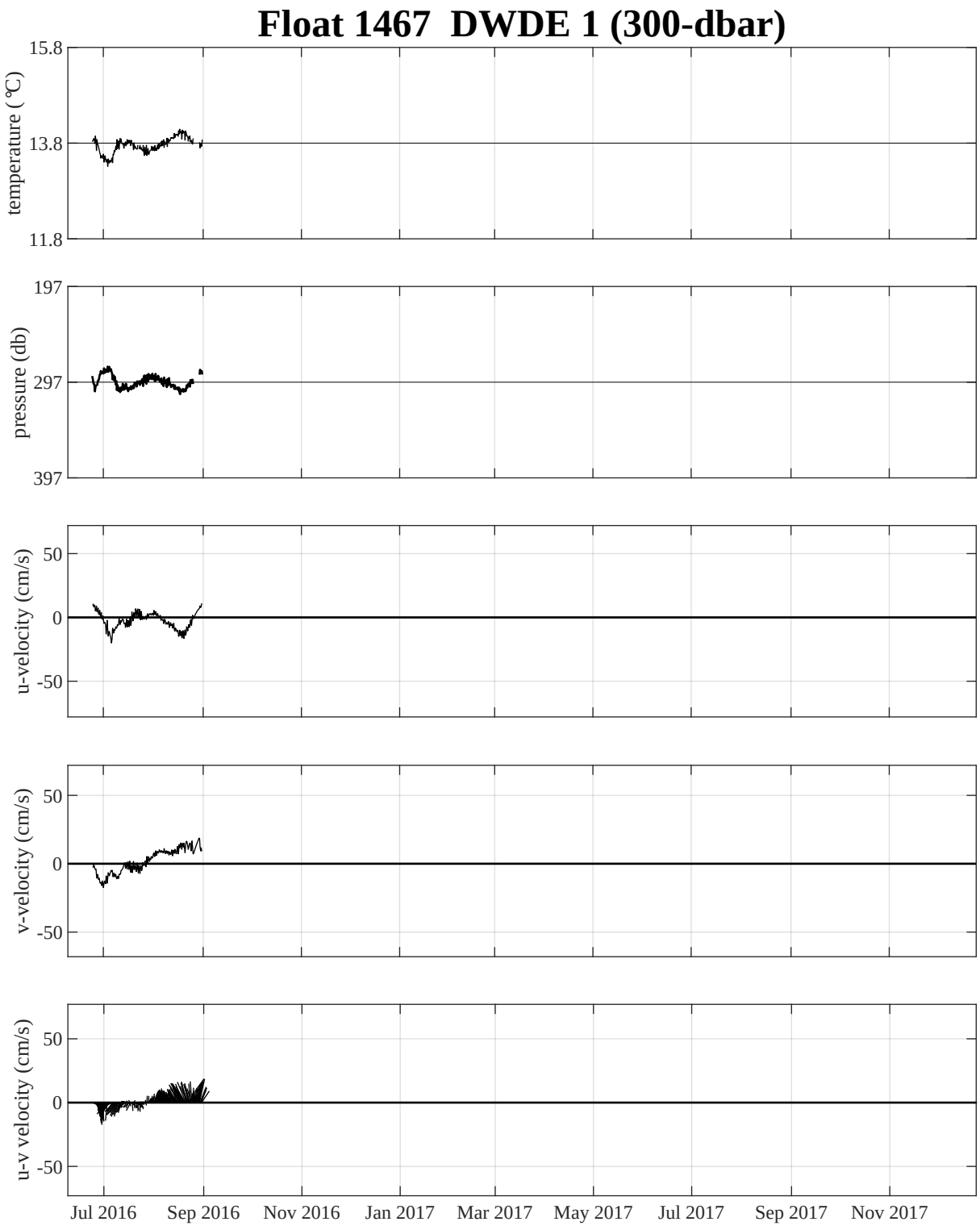

DWDE 1 - 1463
28°N
24°N
20°N
97°W
93°W
89°W
85°W

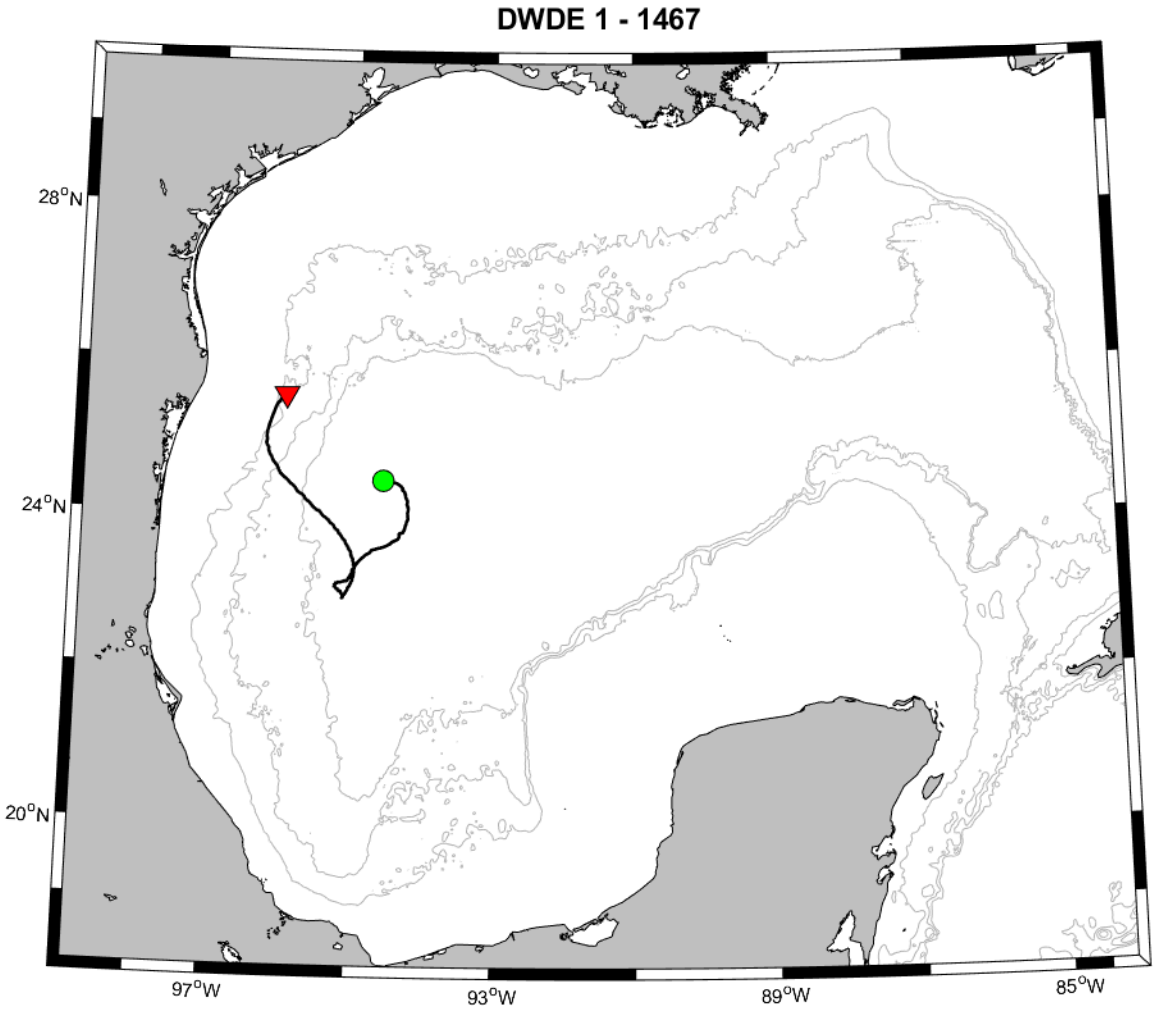

Float 1464 DWDE 1 (300-dbar)
temperature (℃)
14.6
12.6
10.6
pressure (db)
222
322
422
u-velocity (cm/s)
50
0
-50
v-velocity (cm/s)
50
0
-50
u-v velocity (cm/s)
50
0
-50
Jul 2016
Sep 2016
Nov 2016
Jan 2017
Mar 2017
May 2017
Jul 2017
Sep 2017
Nov 2017

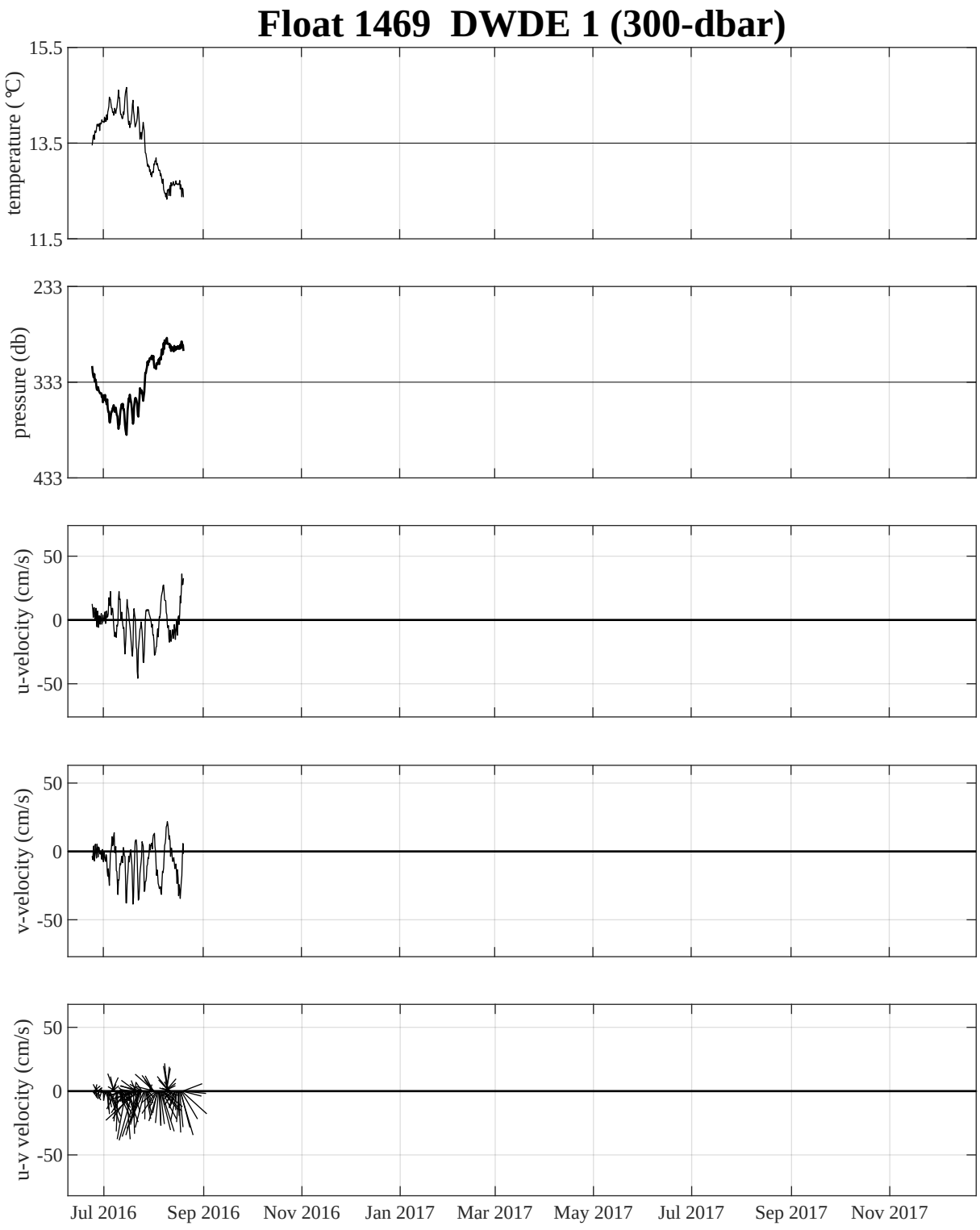

DWDE 1 - 1464
28°N
24°N
20°N
97°W
93°W
89°W
85°W

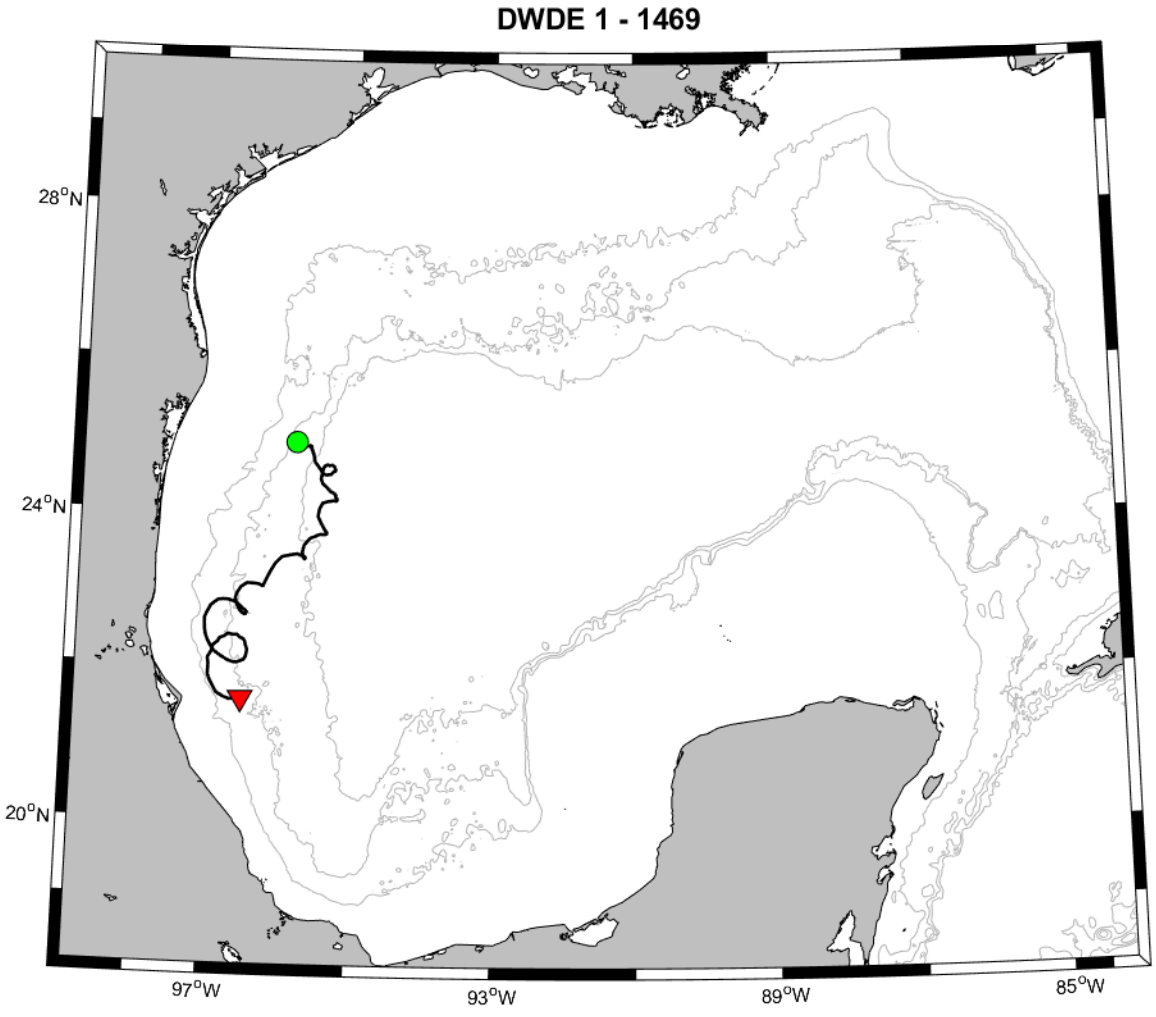

Float 1466 DWDE 1 (300-dbar)
temperature (℃)
14.6
12.6
10.6
pressure (db)
251
351
451
u-velocity (cm/s)
50
0
-50
v-velocity (cm/s)
50
0
-50
u-v velocity (cm/s)
50
0
-50
Jul 2016
Sep 2016
Nov 2016
Jan 2017
Mar 2017
May 2017
Jul 2017
Sep 2017
Nov 2017

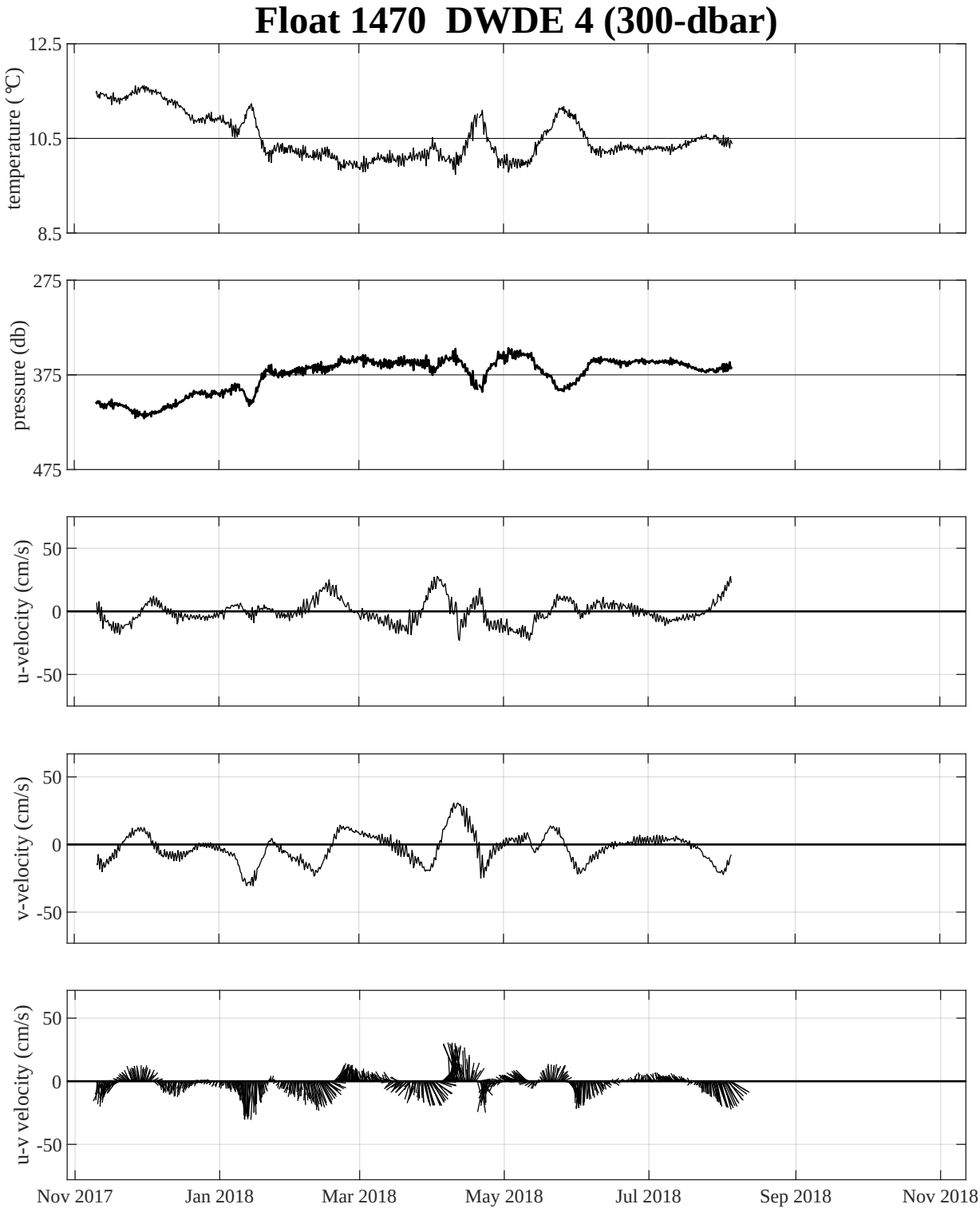

DWDE 1 - 1466
28°N
24°N
20°N
97°W
93°W
89°W
85°W

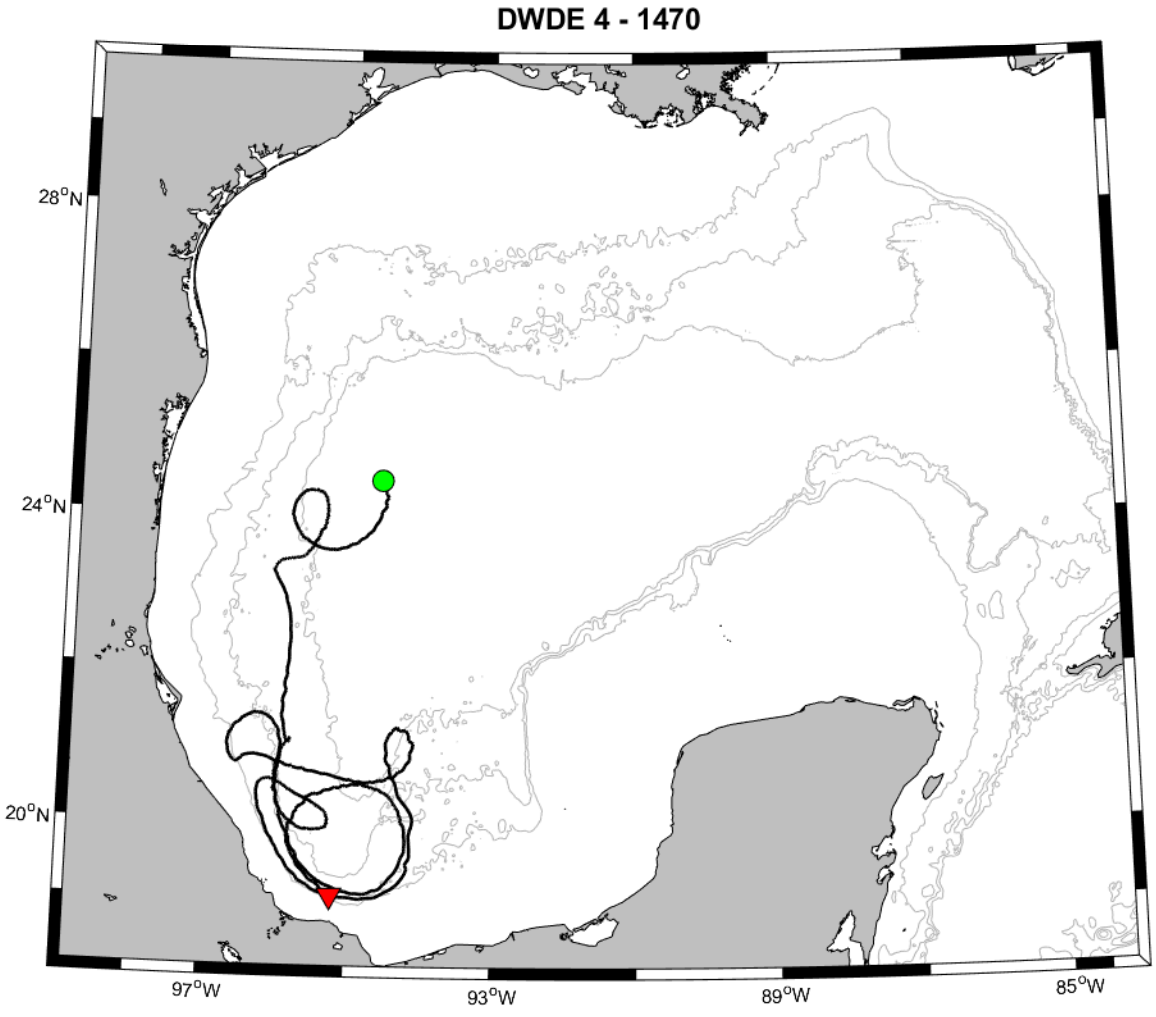

Float 1467 DWDE 1 (300-dbar)
temperature (℃)
15.8
13.8
11.8
pressure (db)
197
297
397
u-velocity (cm/s)
50
0
-50
v-velocity (cm/s)
50
0
-50
u-v velocity (cm/s)
50
0
-50
Jul 2016
Sep 2016
Nov 2016
Jan 2017
Mar 2017
May 2017
Jul 2017
Sep 2017
Nov 2017

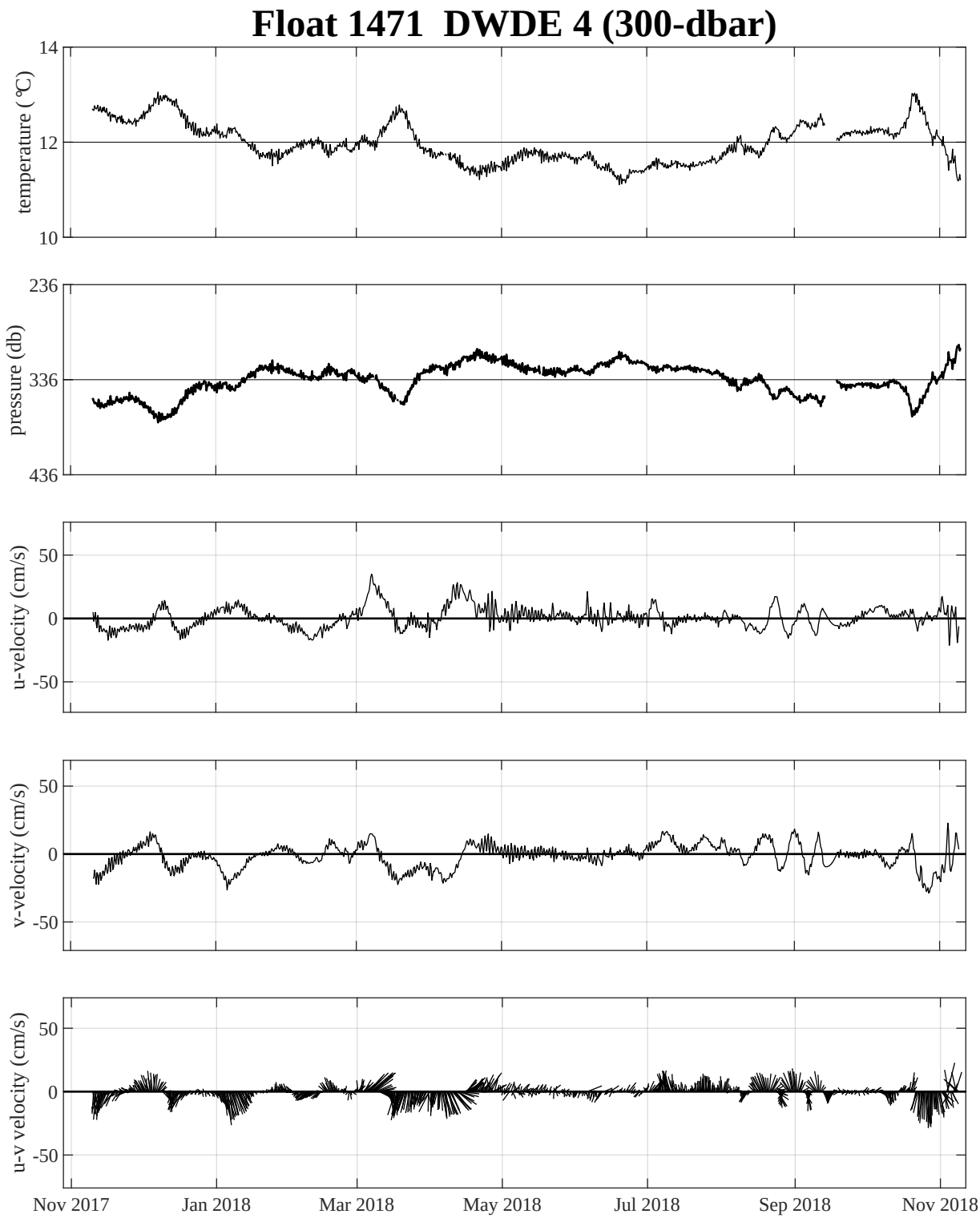

DWDE 1 - 1467
28°N
24°N
20°N
97°W
93°W
89°W
85°W

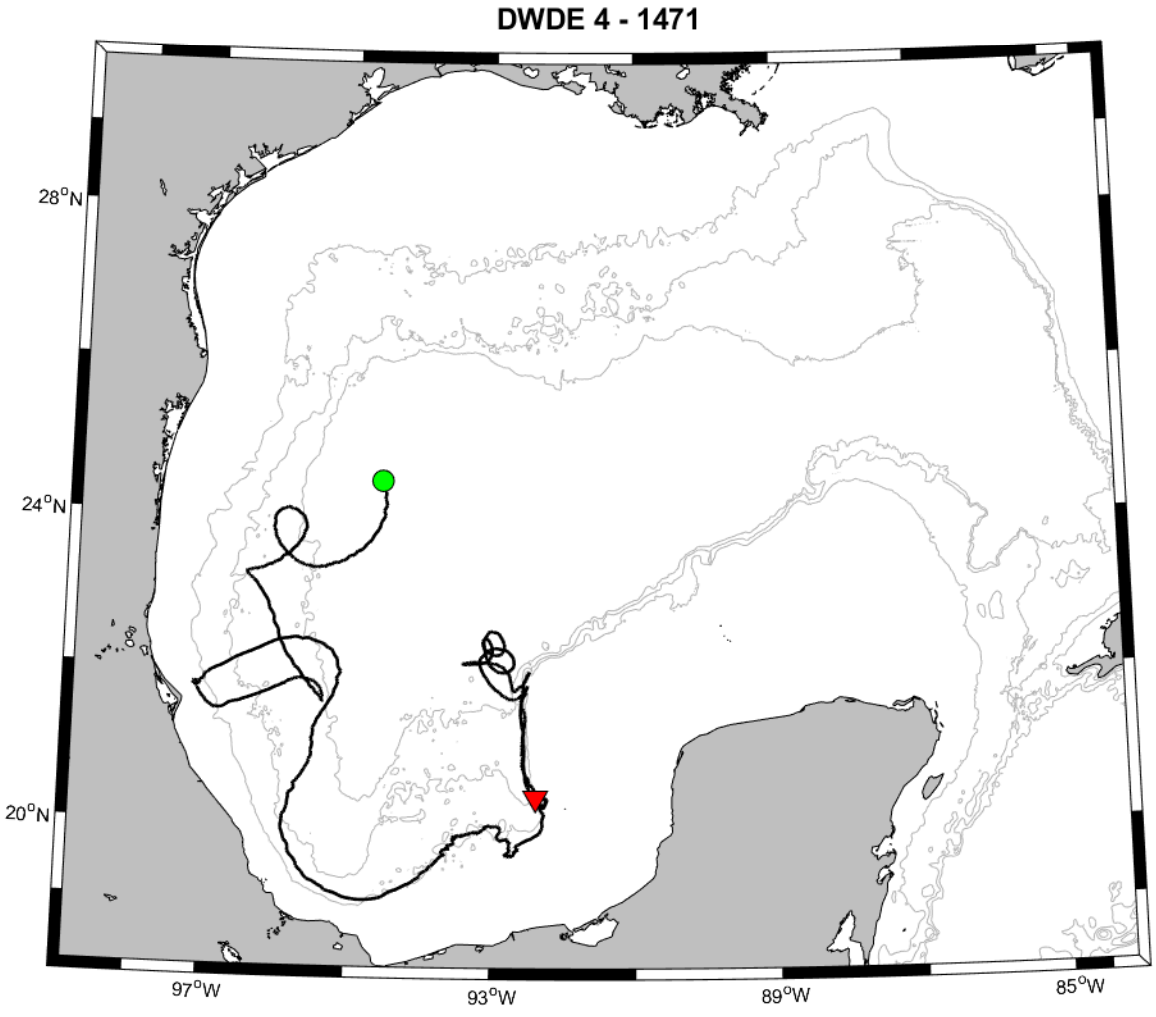

Float 1469 DWDE 1 (300-dbar)
temperature (℃)
15.5
13.5
11.5
pressure (db)
233
333
433
u-velocity (cm/s)
50
0
-50
v-velocity (cm/s)
50
0
-50
u-v velocity (cm/s)
50
0
-50
Jul 2016
Sep 2016
Nov 2016
Jan 2017
Mar 2017
May 2017
Jul 2017
Sep 2017
Nov 2017

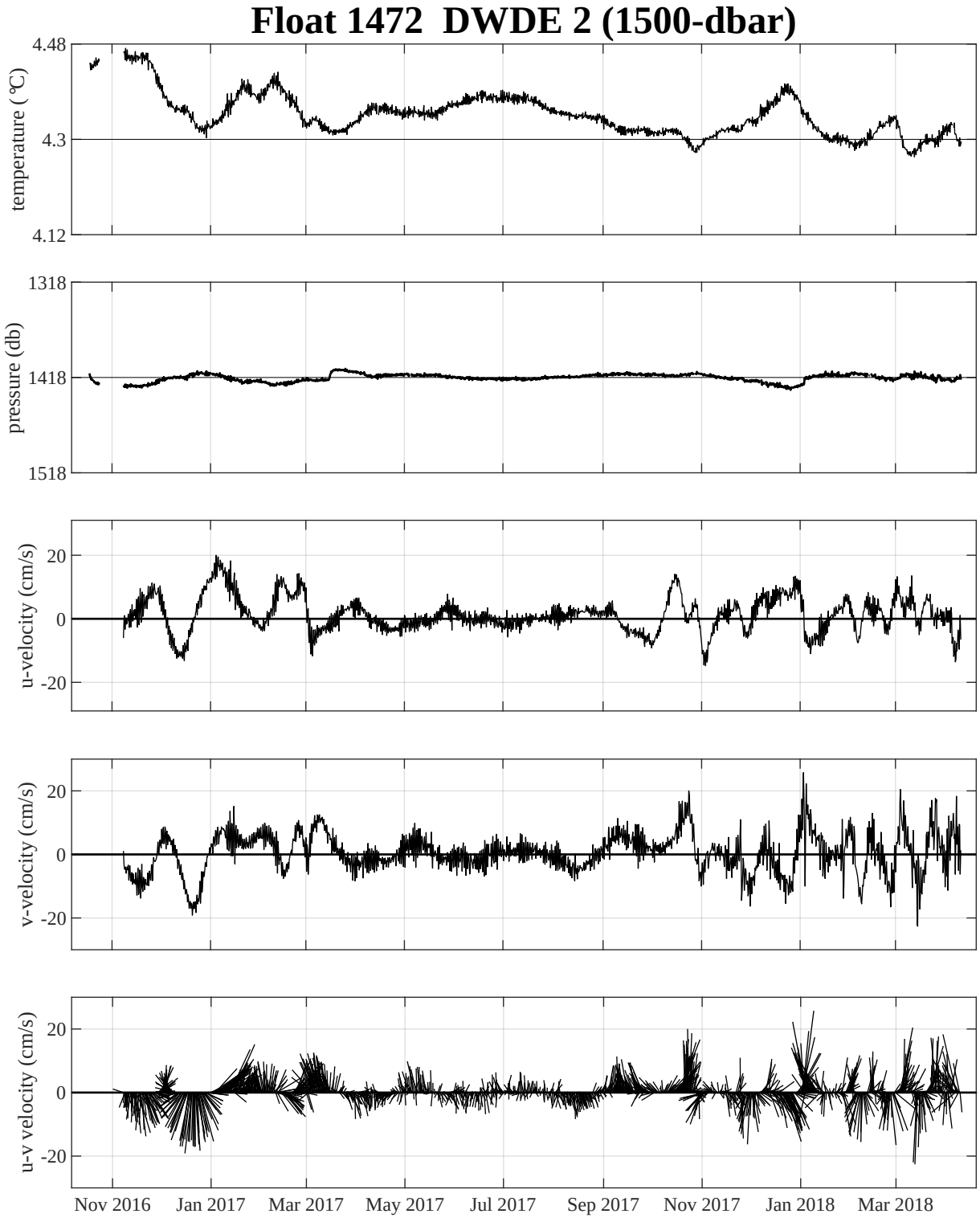

DWDE 1 - 1469
28°N
24°N
20°N
97°W
93°W
89°W
85°W

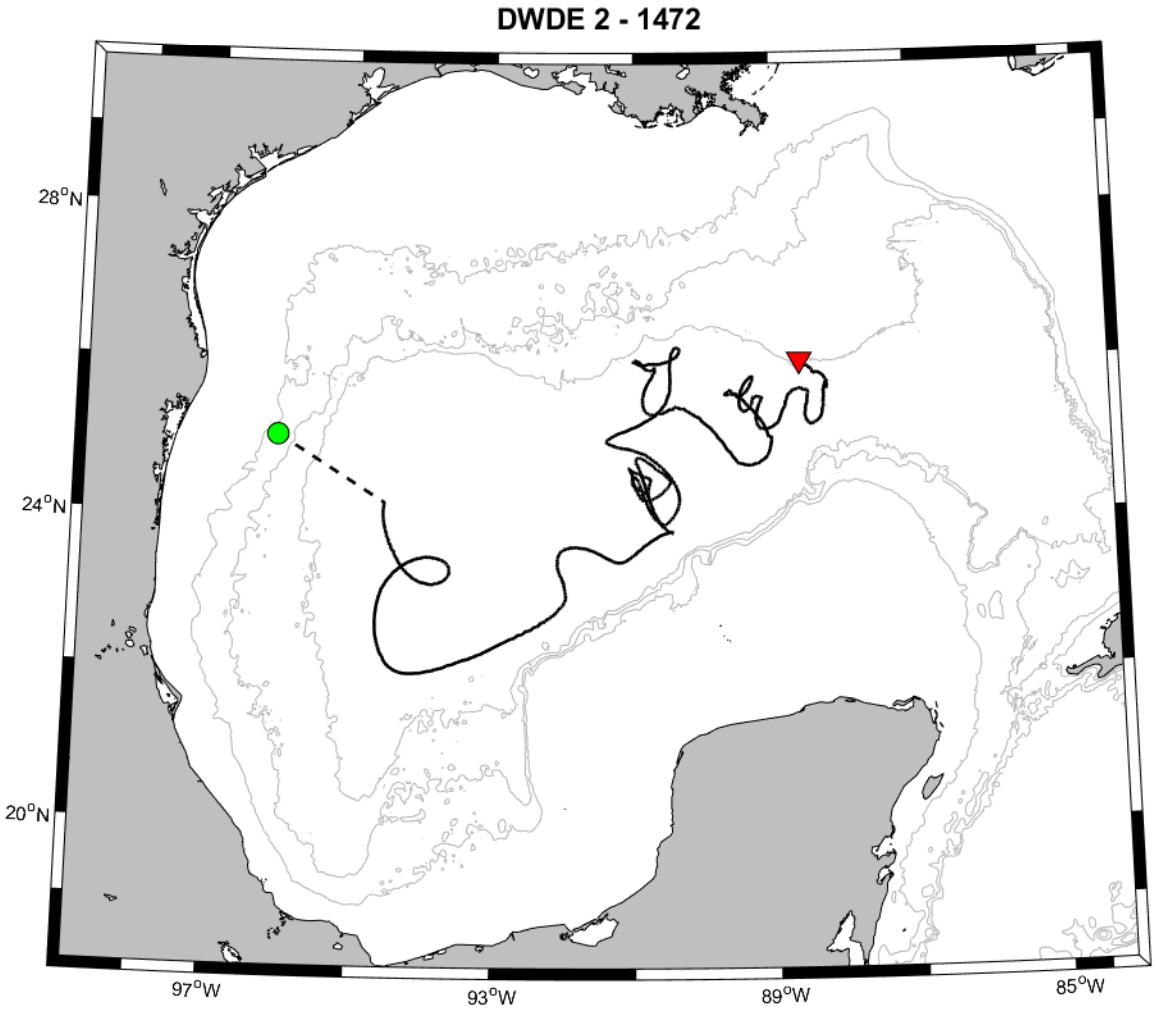

Float 1470 DWDE 4 (300-dbar)
temperature (℃)
12.5
10.5
8.5
pressure (db)
275
375
475
u-velocity (cm/s)
50
0
-50
v-velocity (cm/s)
50
0
-50
u-v velocity (cm/s)
50
0
-50
Nov 2017
Jan 2018
Mar 2018
May 2018
Jul 2018
Sep 2018
Nov 2018

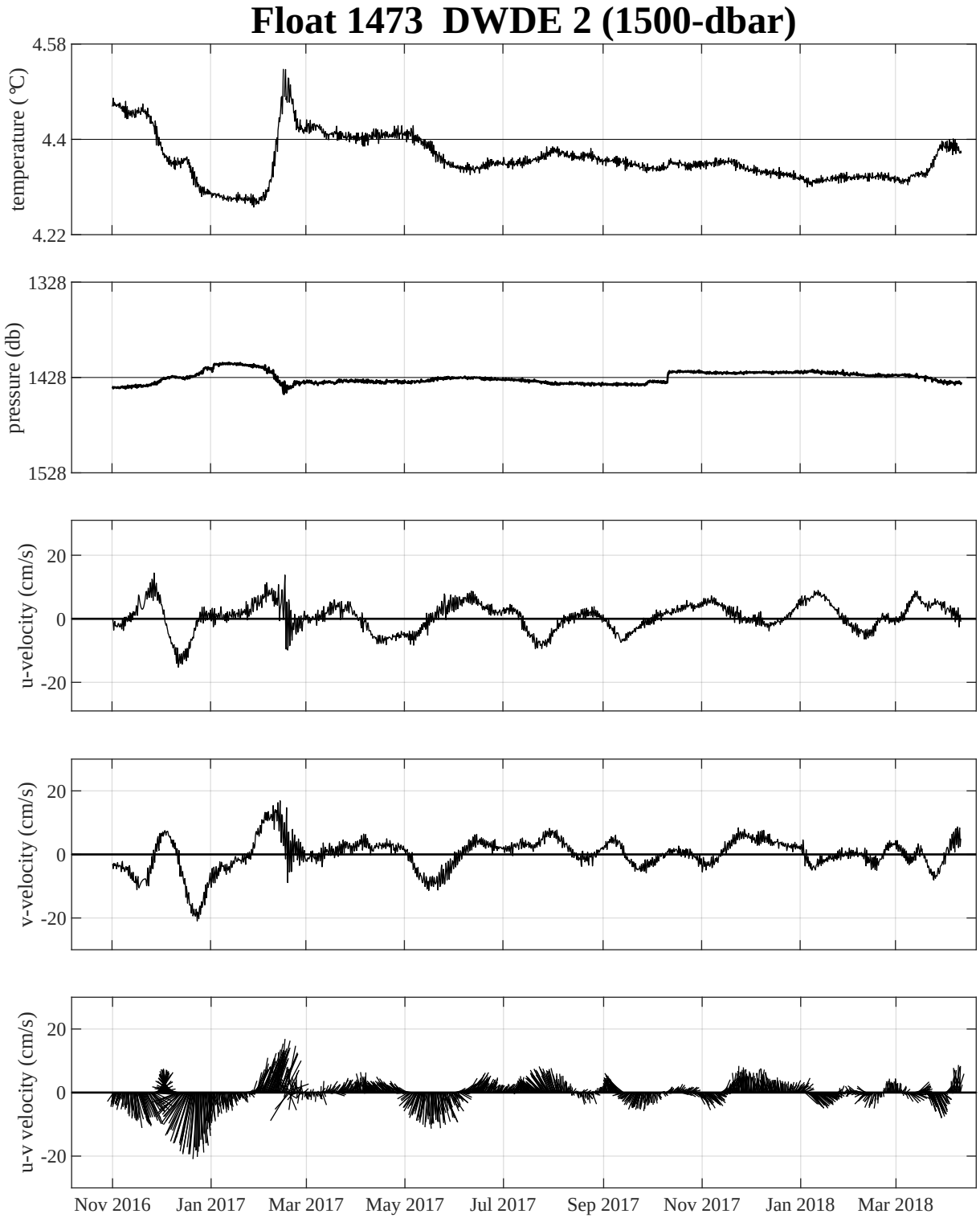

DWDE 4 - 1470
28°N
24°N
20°N
97°W
93°W
89°W
85°W

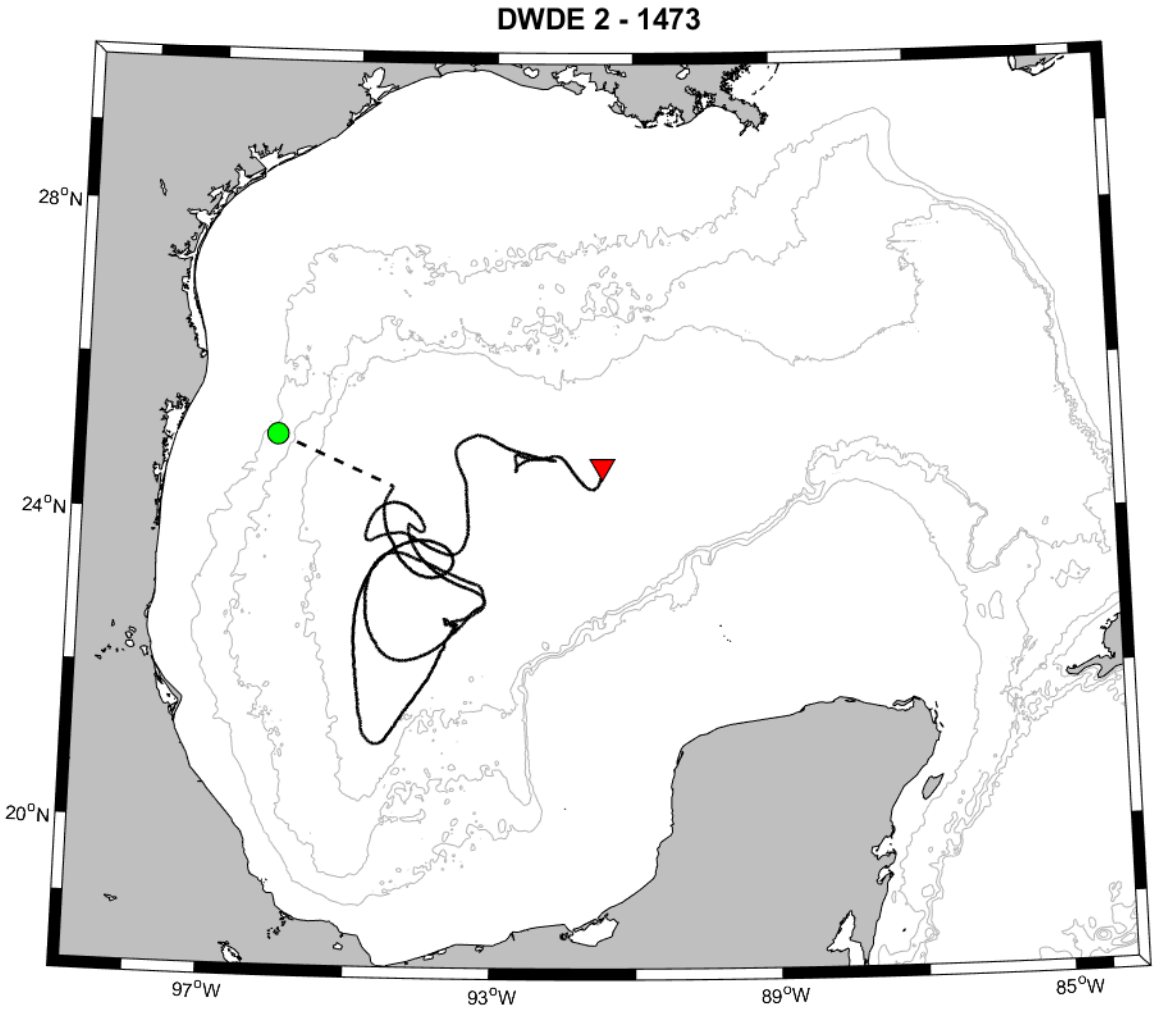

Float 1471 DWDE 4 (300-dbar)
temperature (°C)
14
12
10
pressure (db)
236
336
436
u-velocity (cm/s)
50
0
-50
v-velocity (cm/s)
50
0
-50
u-v velocity (cm/s)
50
0
-50
Nov 2017
Jan 2018
Mar 2018
May 2018
Jul 2018
Sep 2018
Nov 2018

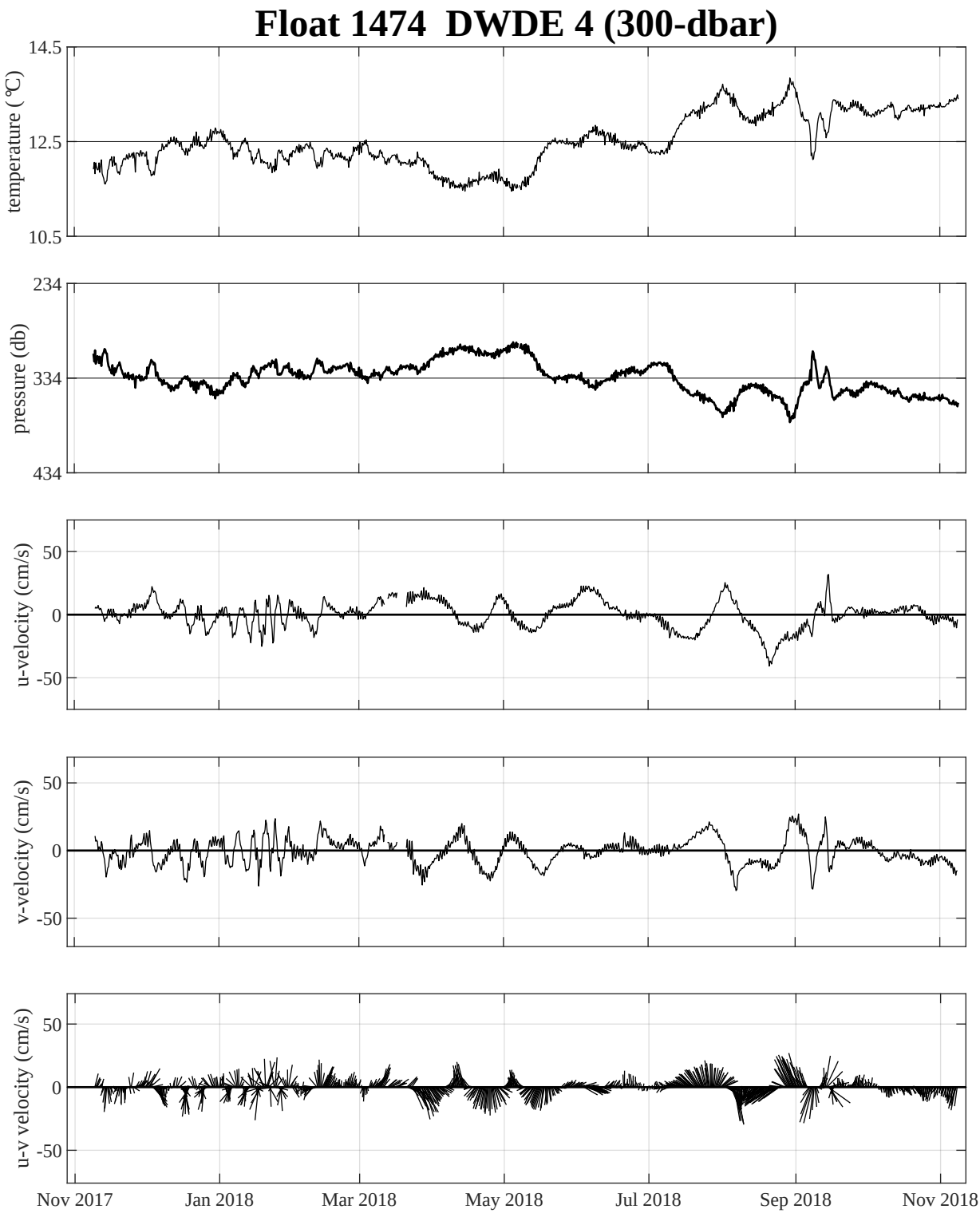

DWDE 4 - 1471
28°N
24°N
20°N
97°W
93°W
89°W
85°W

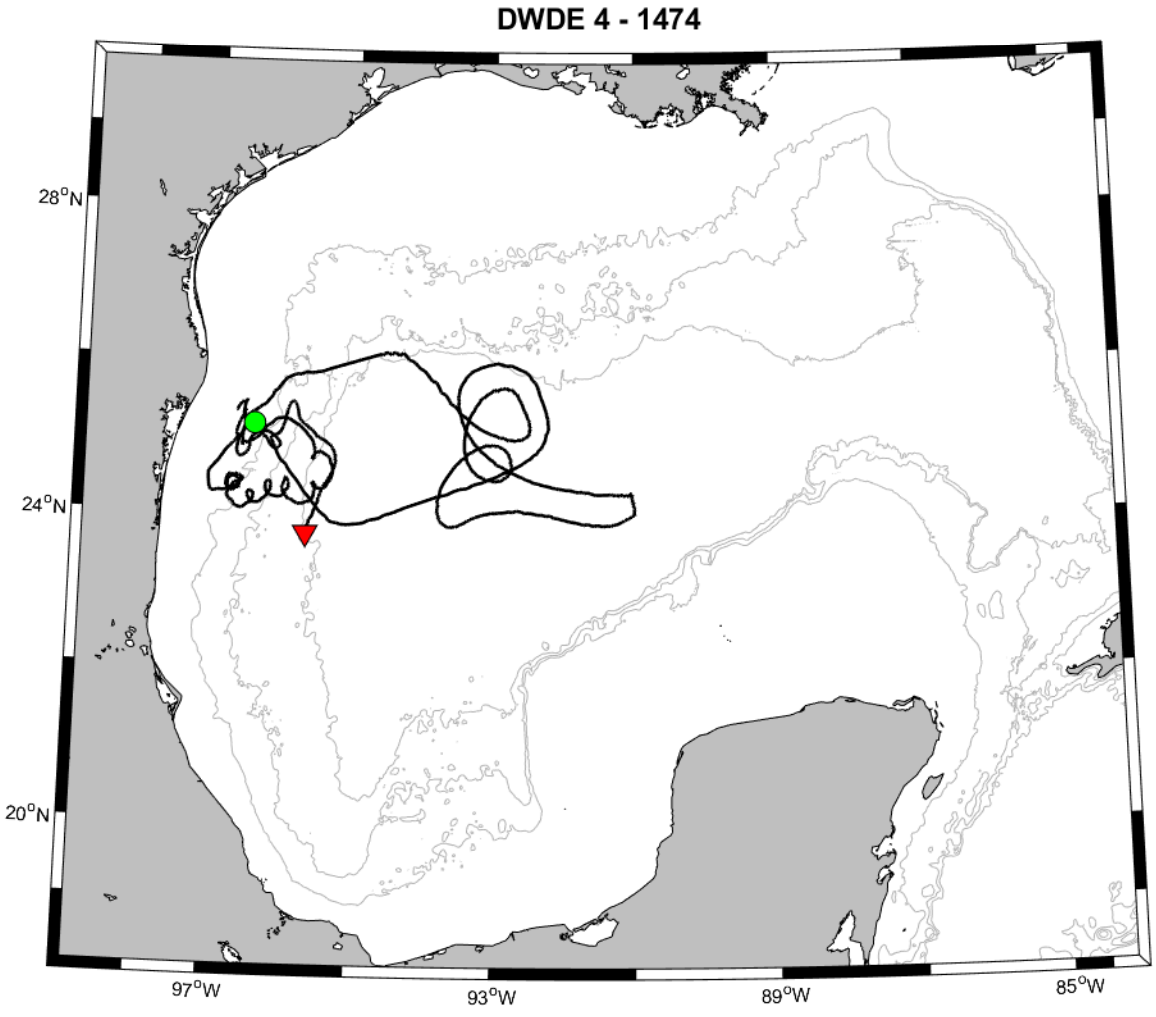

Float 1472 DWDE 2 (1500-dbar)
temperature (℃)
4.48
4.3
4.12
pressure (db)
1318
1418
1518
u-velocity (cm/s)
20
0
-20
v-velocity (cm/s)
20
0
-20
u-v velocity (cm/s)
20
0
-20
Nov 2016
Jan 2017
Mar 2017
May 2017
Jul 2017
Sep 2017
Nov 2017
Jan 2018
Mar 2018

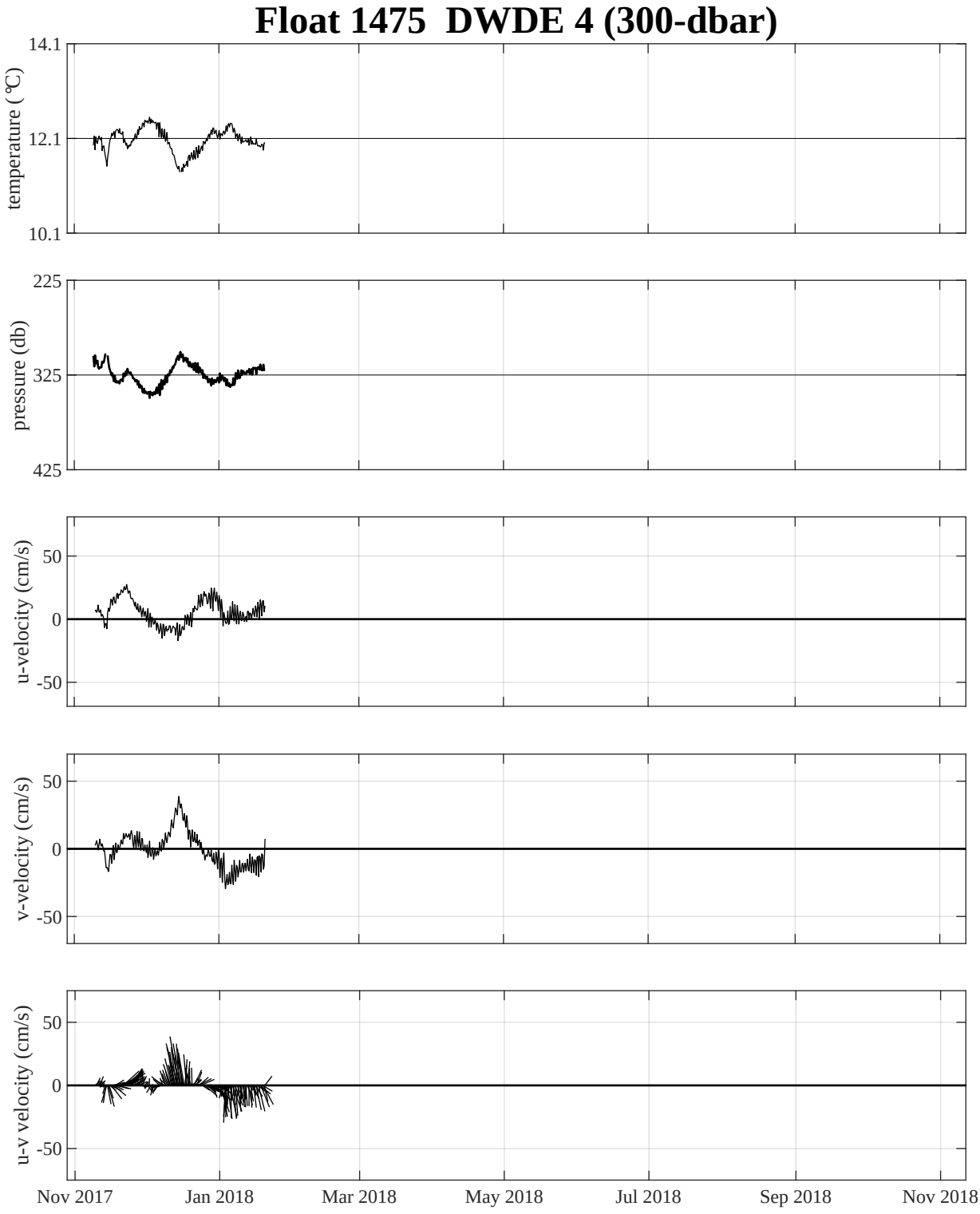

DWDE 2 - 1472
28°N
24°N
20°N
97°W
93°W
89°W
85°W

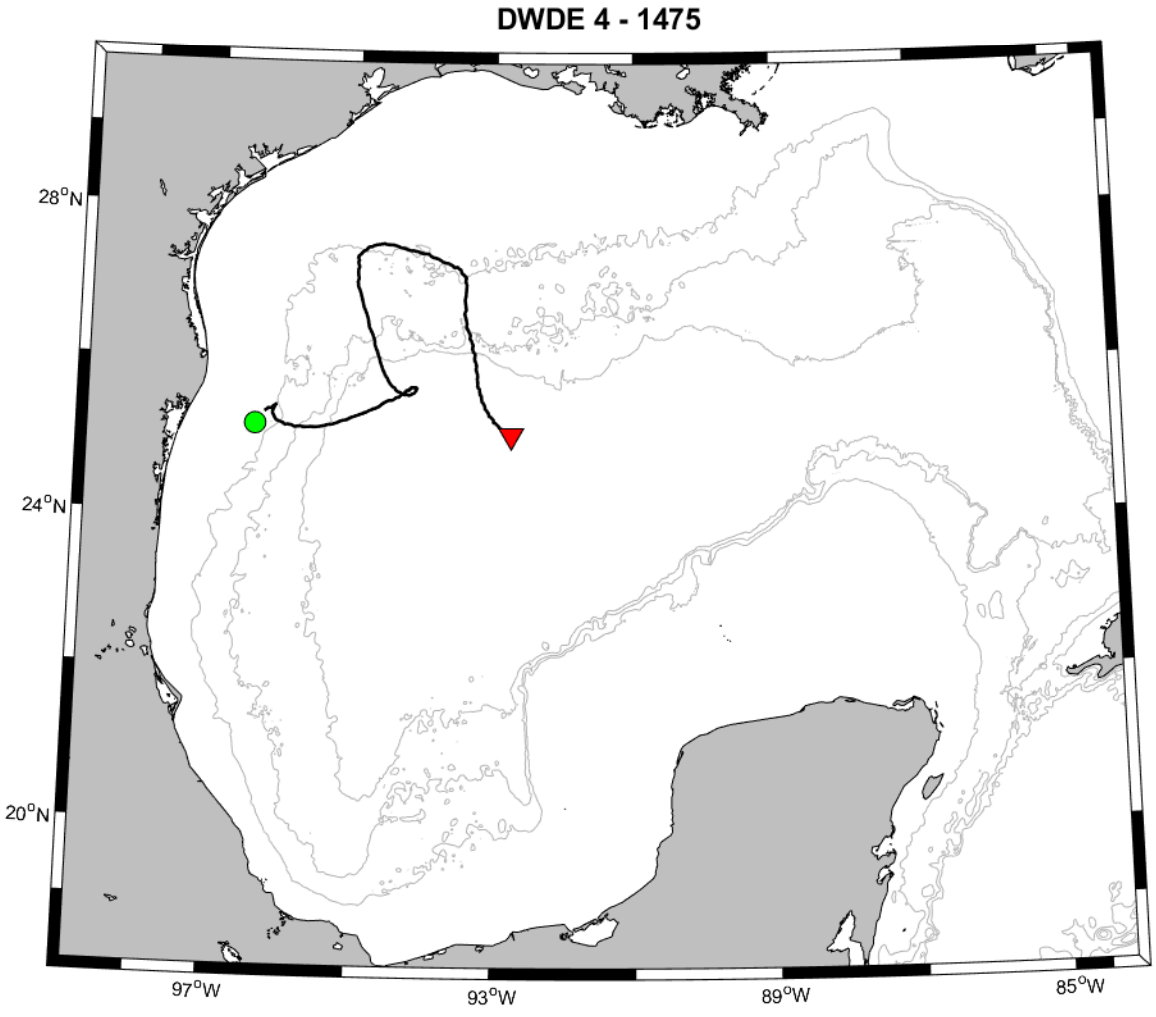

Float 1473 DWDE 2 (1500-dbar)
temperature (℃)
4.58
4.4
4.22
pressure (db)
1328
1428
1528
u-velocity (cm/s)
20
0
-20
v-velocity (cm/s)
20
0
-20
u-v velocity (cm/s)
20
0
-20
Nov 2016
Jan 2017
Mar 2017
May 2017
Jul 2017
Sep 2017
Nov 2017
Jan 2018
Mar 2018

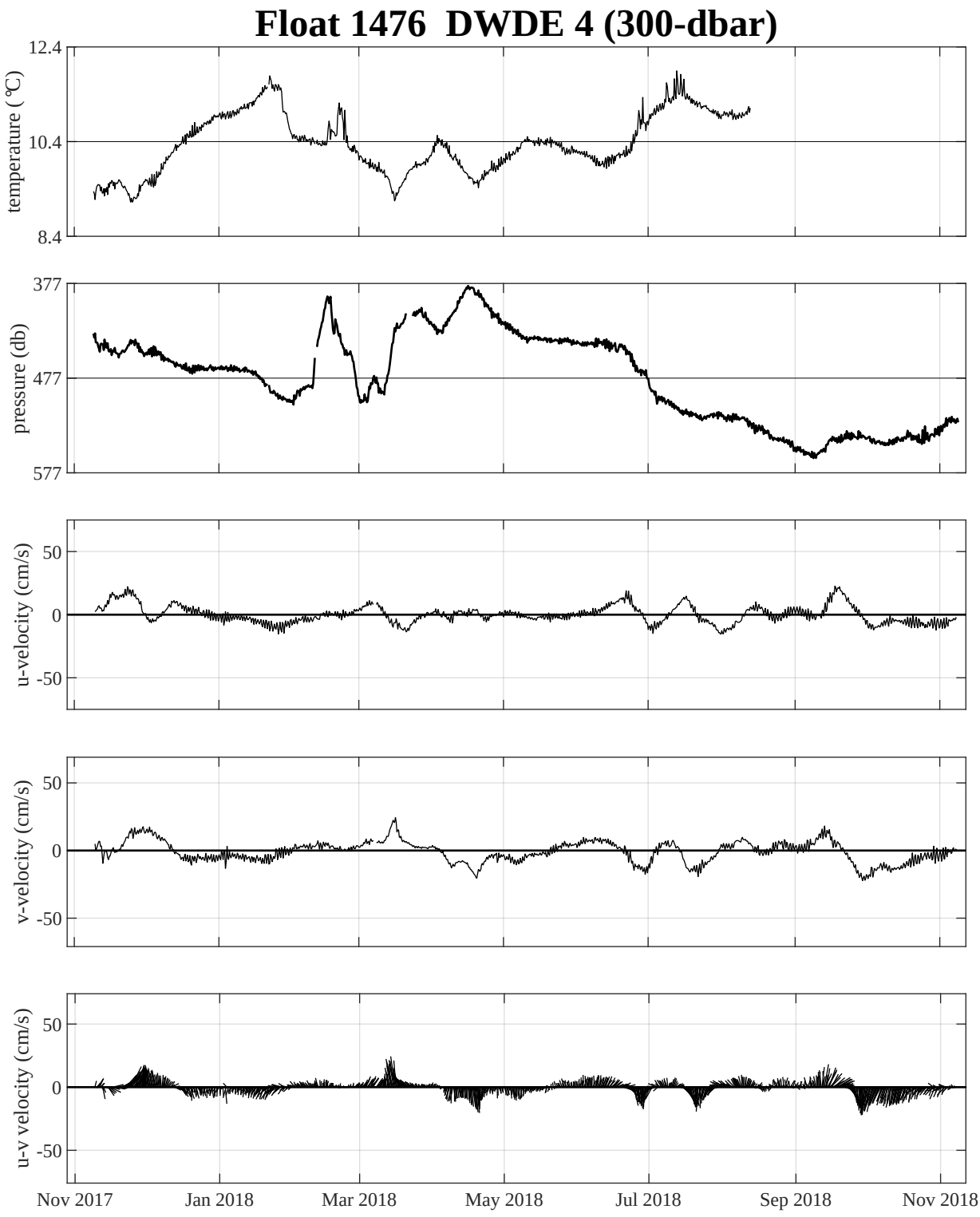

DWDE 2 - 1473
28°N
24°N
20°N
97°W
93°W
89°W
85°W

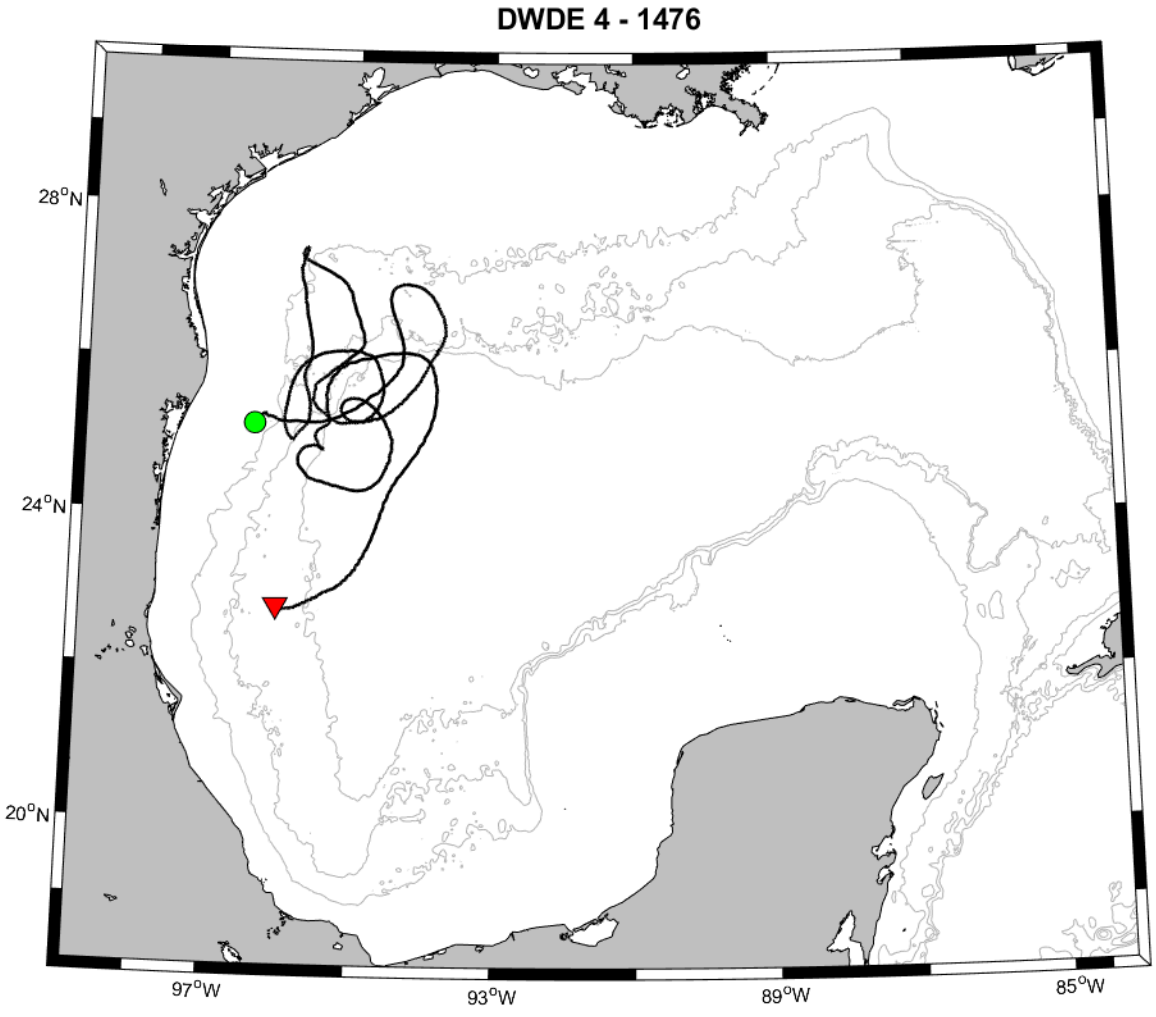

Float 1474 DWDE 4 (300-dbar)
temperature (℃)
14.5
12.5
10.5
pressure (db)
234
334
434
u-velocity (cm/s)
50
0
-50
v-velocity (cm/s)
50
0
-50
u-v velocity (cm/s)
50
0
-50
Nov 2017
Jan 2018
Mar 2018
May 2018
Jul 2018
Sep 2018
Nov 2018

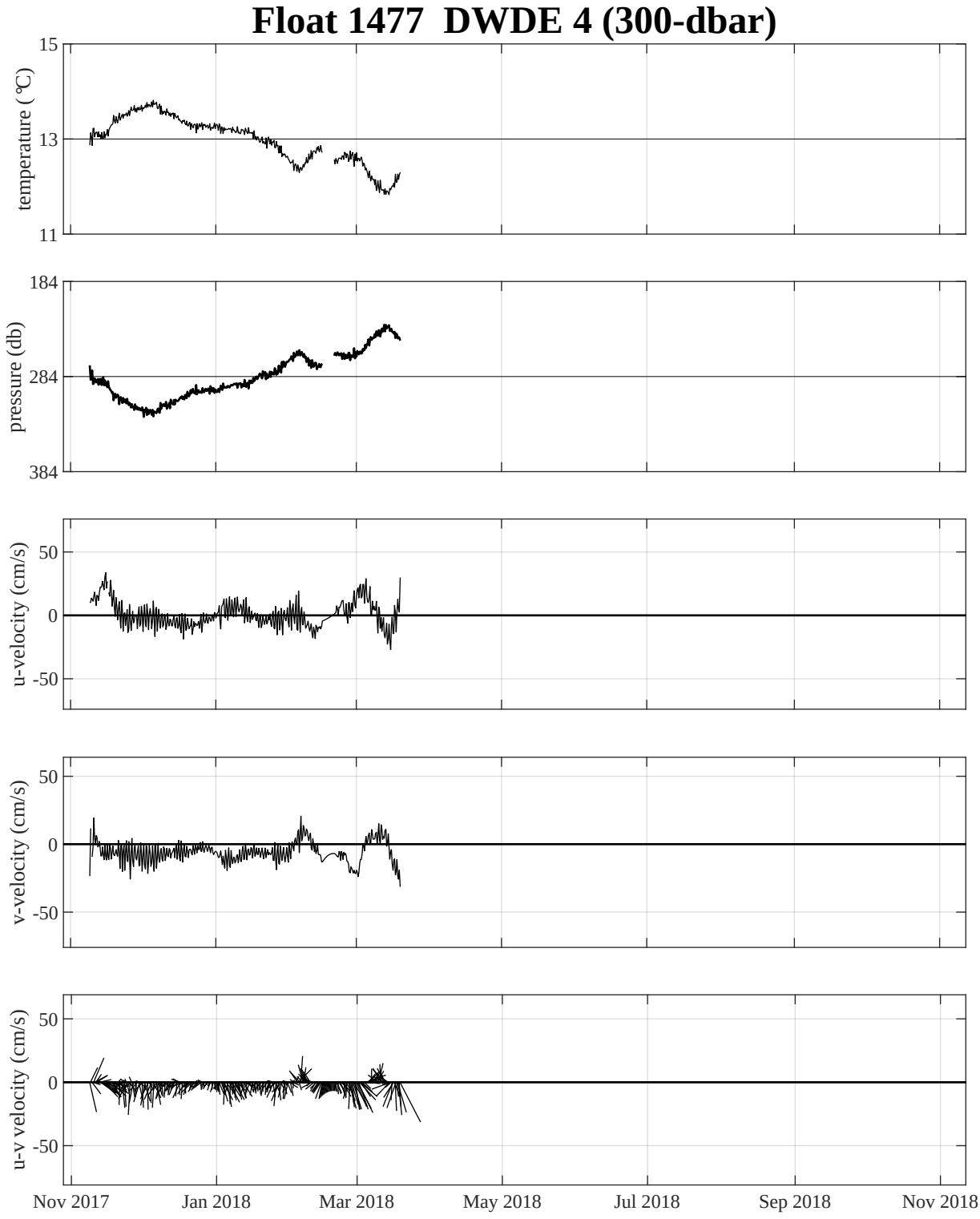

DWDE 4 - 1474
28°N
24°N
20°N
97°W
93°W
89°W
85°W

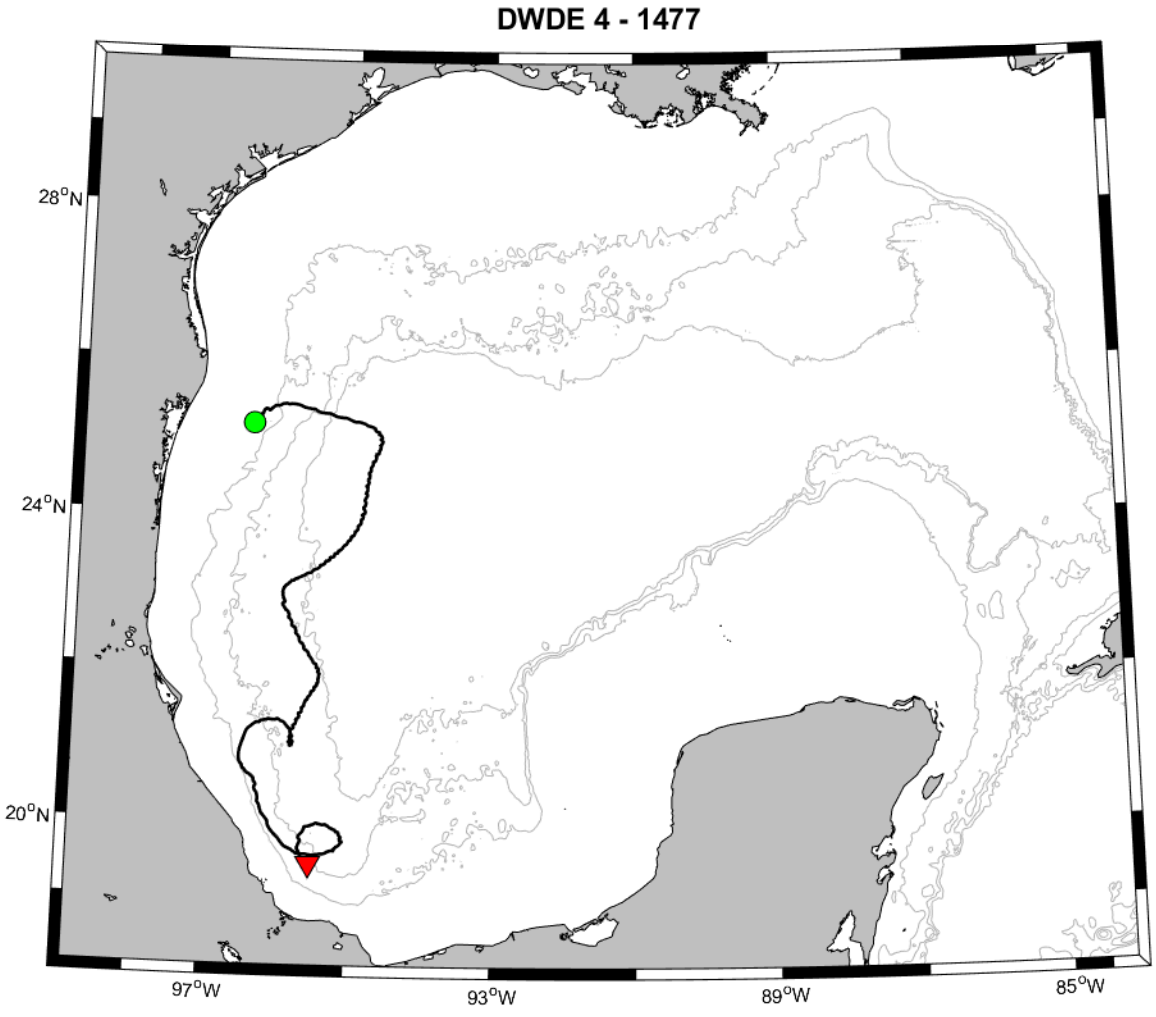

Float 1475 DWDE 4 (300-dbar)
temperature (℃)
14.1
12.1
10.1
pressure (db)
225
325
425
u-velocity (cm/s)
50
0
-50
v-velocity (cm/s)
50
0
-50
u-v velocity (cm/s)
50
0
-50
Nov 2017
Jan 2018
Mar 2018
May 2018
Jul 2018
Sep 2018
Nov 2018

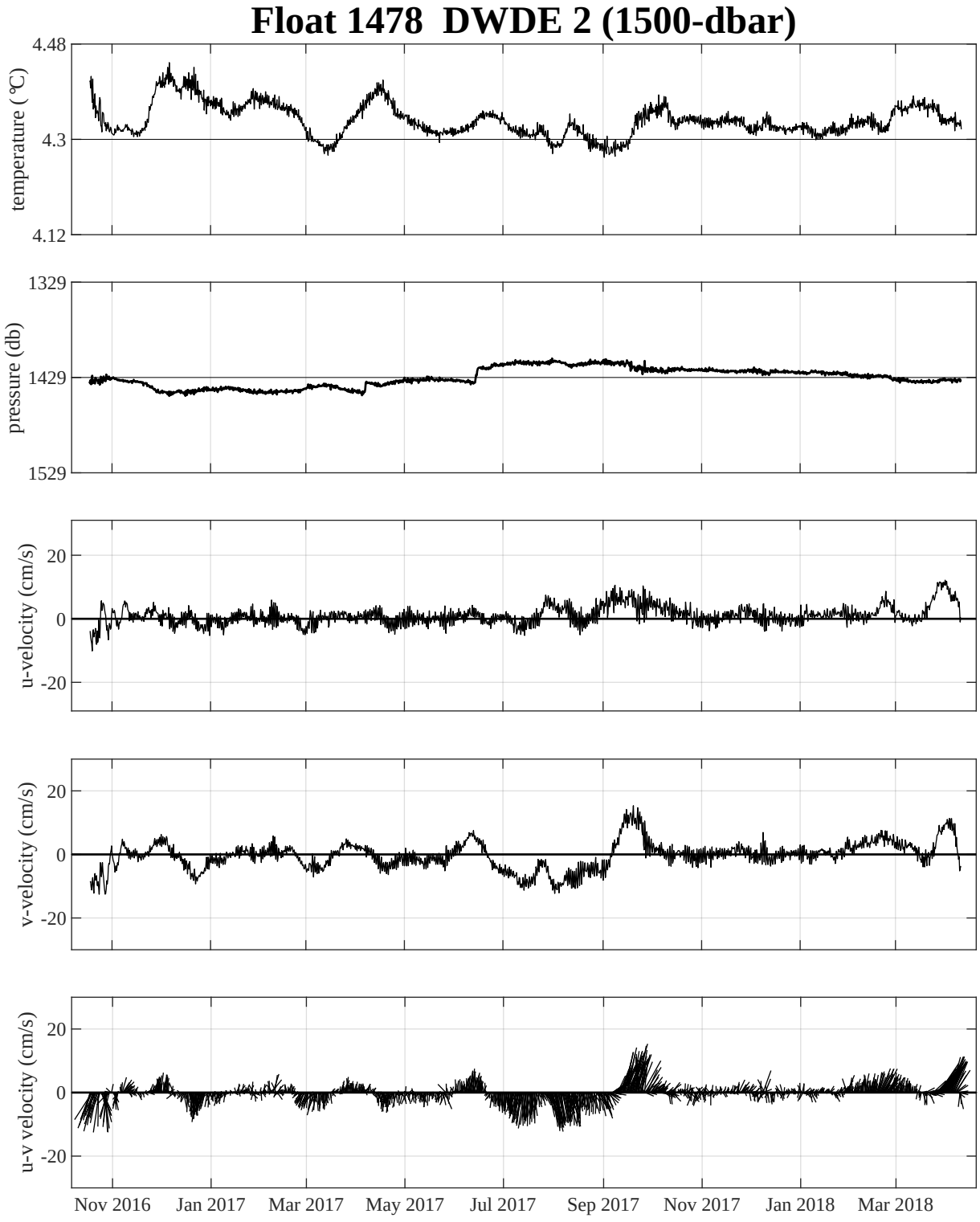

DWDE 4 - 1475
28°N
24°N
20°N
97°W
93°W
89°W
85°W

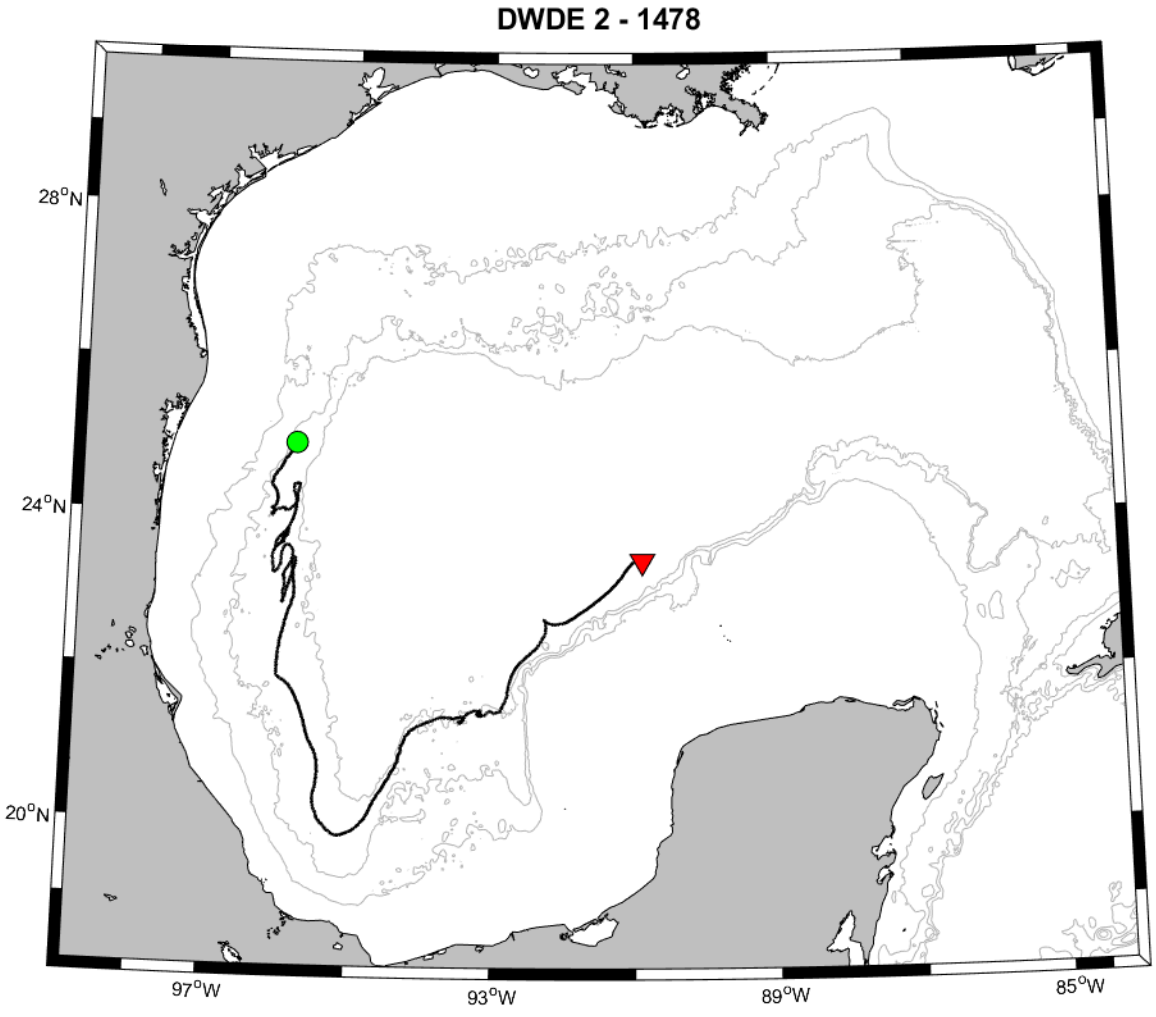

Float 1476 DWDE 4 (300-dbar)
temperature (℃)
12.4
10.4
8.4
pressure (db)
377
477
577
u-velocity (cm/s)
50
0
-50
v-velocity (cm/s)
50
0
-50
u-v velocity (cm/s)
50
0
-50
Nov 2017
Jan 2018
Mar 2018
May 2018
Jul 2018
Sep 2018
Nov 2018

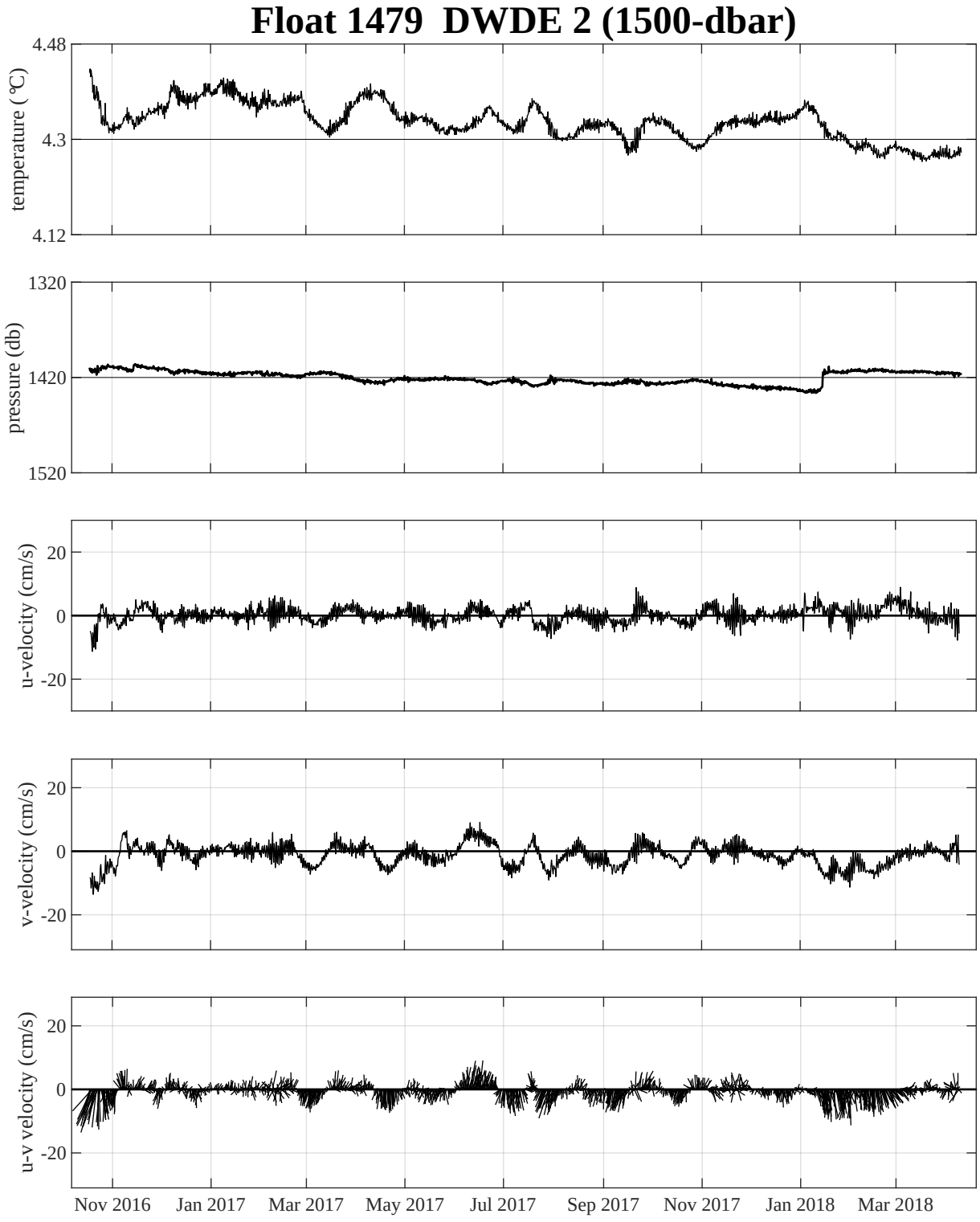

DWDE 4 - 1476
28°N
24°N
20°N
97°W
93°W
89°W
85°W

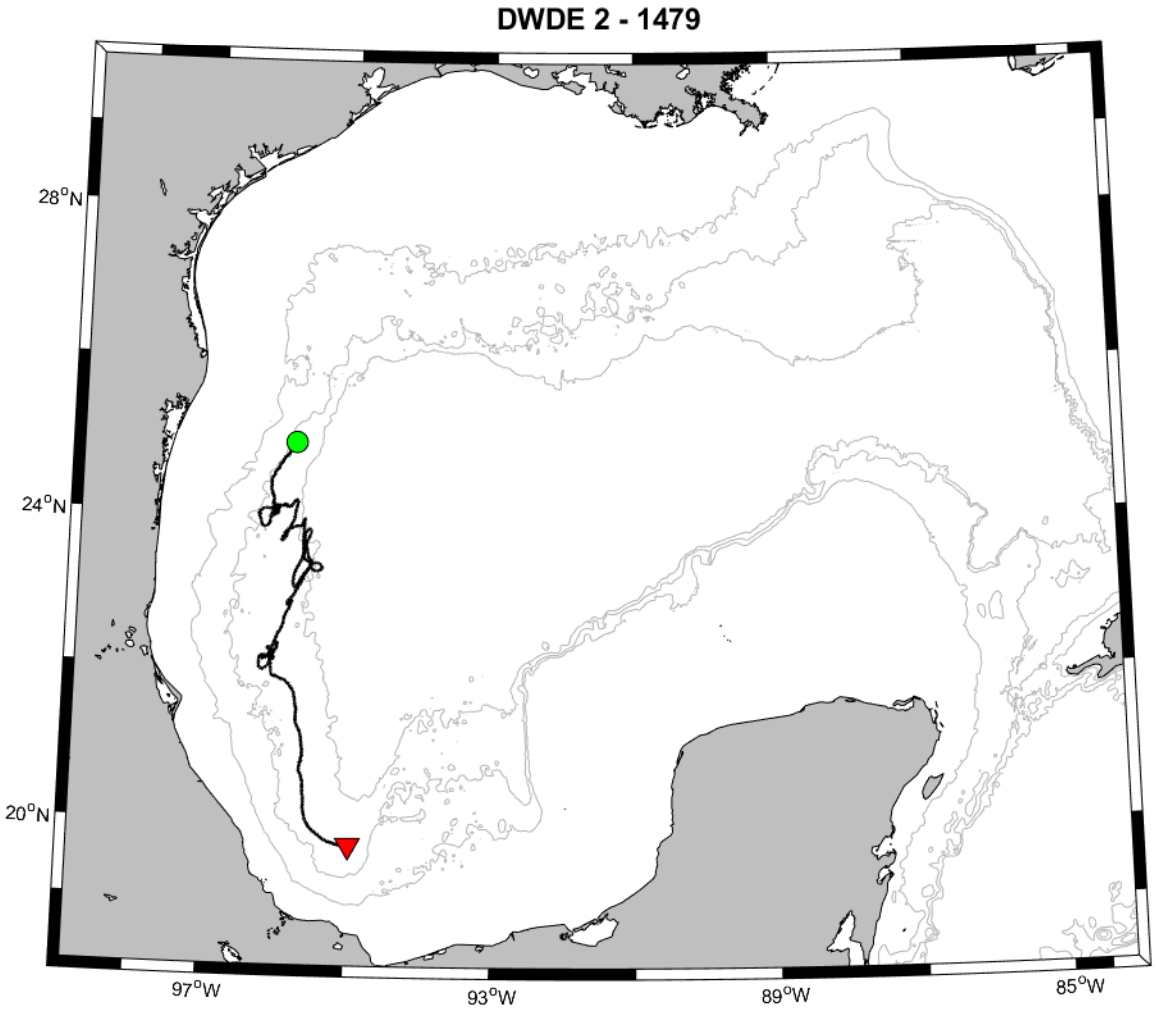

Float 1477 DWDE 4 (300-dbar)
temperature (°C)
15
13
11
pressure (db)
184
284
384
u-velocity (cm/s)
50
0
-50
v-velocity (cm/s)
50
0
-50
u-v velocity (cm/s)
50
0
-50
Nov 2017
Jan 2018
Mar 2018
May 2018
Jul 2018
Sep 2018
Nov 2018

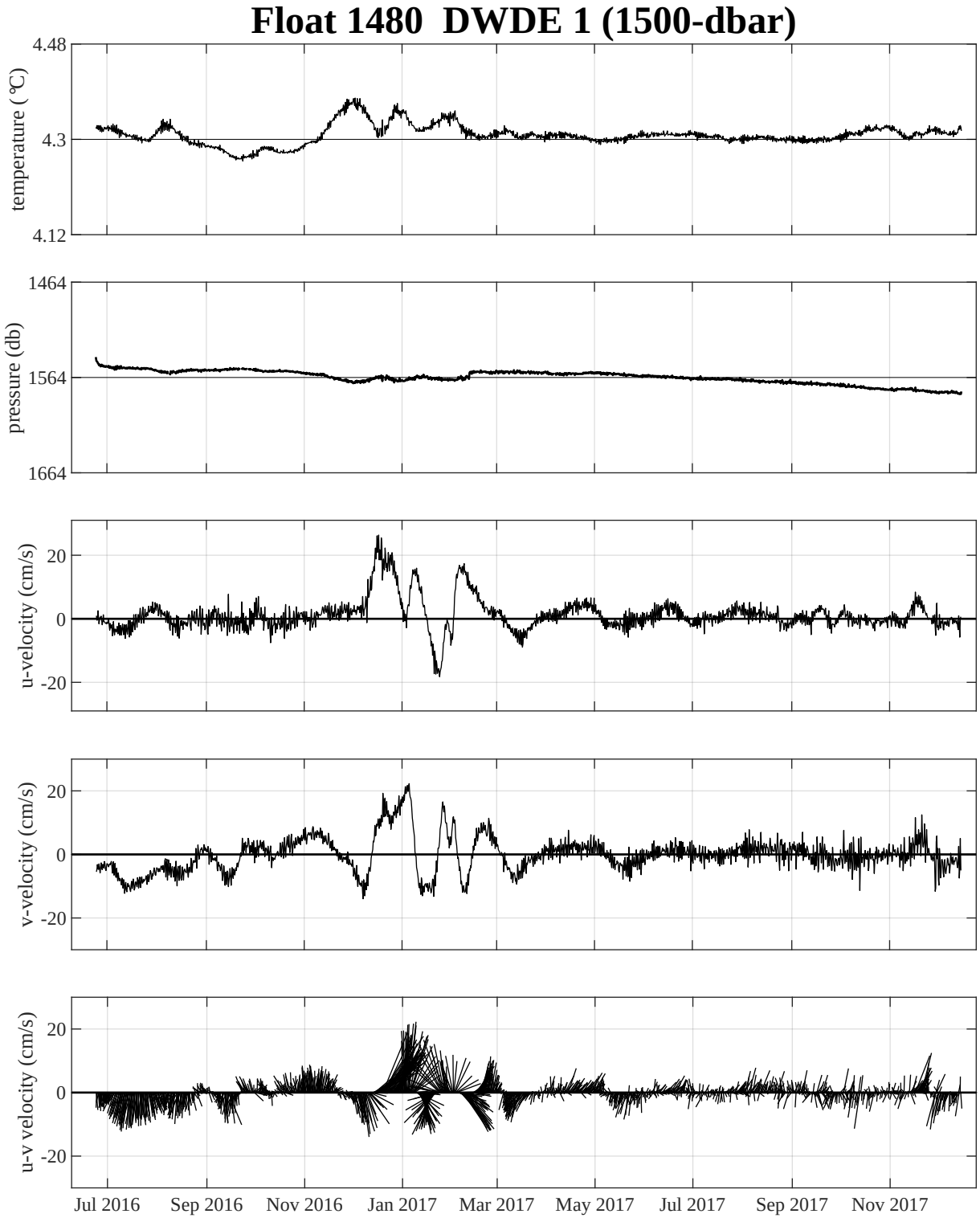

DWDE 4 - 1477
28°N
24°N
20°N
97°W
93°W
89°W
85°W

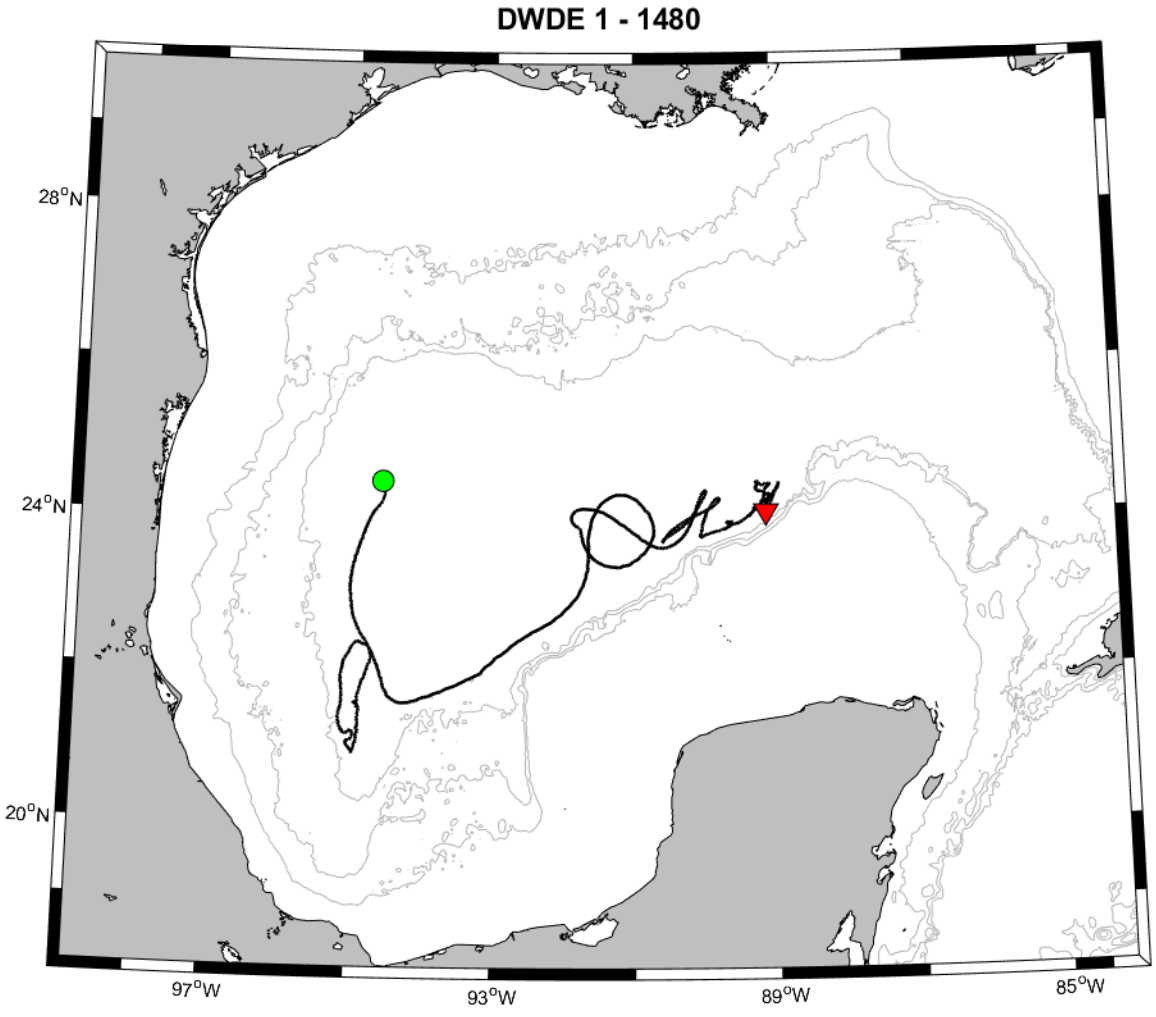

Float 1478 DWDE 2 (1500-dbar)
temperature (℃)
4.48
4.3
4.12
pressure (db)
1329
1429
1529
u-velocity (cm/s)
20
0
-20
v-velocity (cm/s)
20
0
-20
u-v velocity (cm/s)
20
0
-20
Nov 2016
Jan 2017
Mar 2017
May 2017
Jul 2017
Sep 2017
Nov 2017
Jan 2018
Mar 2018

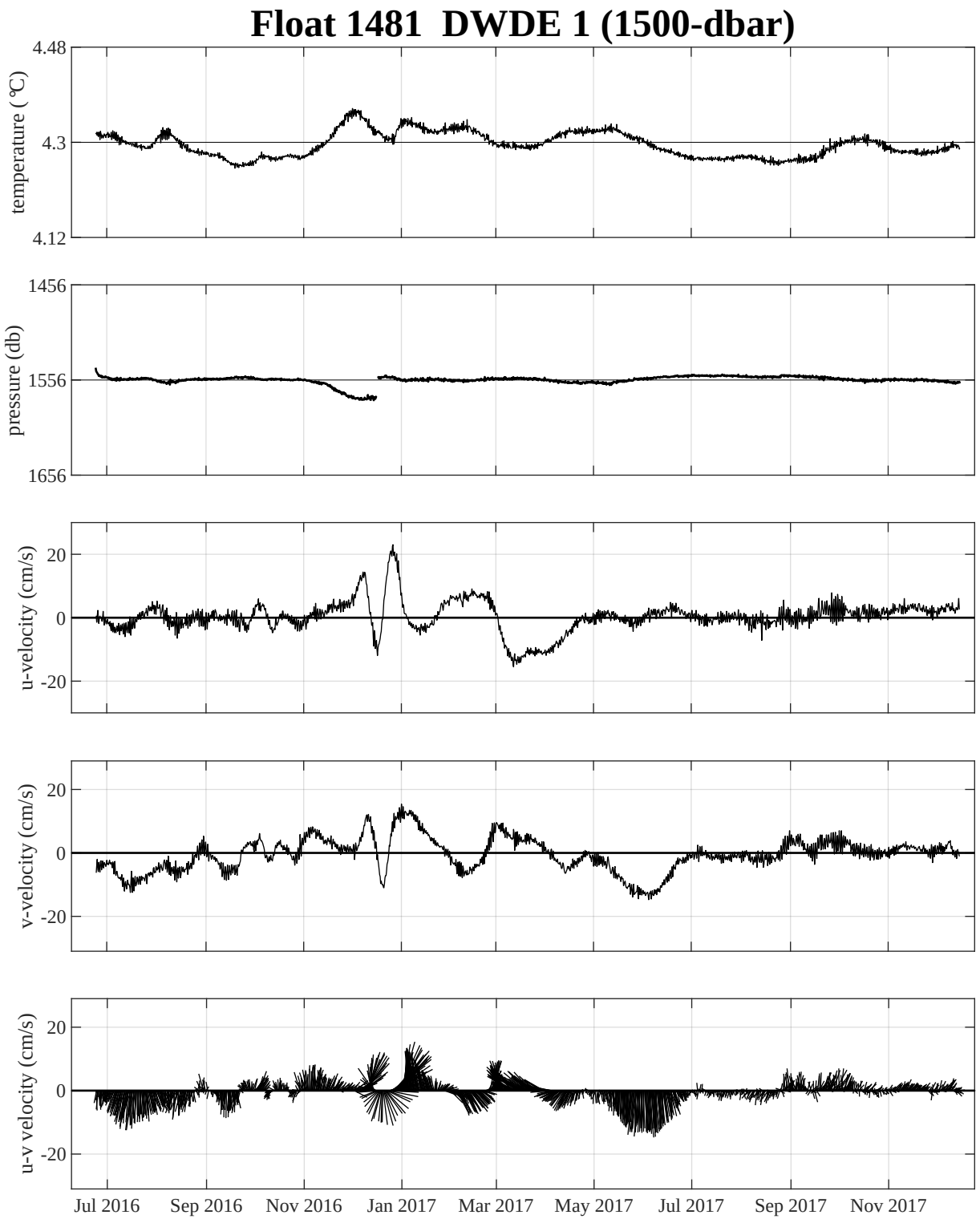

DWDE 2 - 1478
28°N
24°N
20°N
97°W
93°W
89°W
85°W

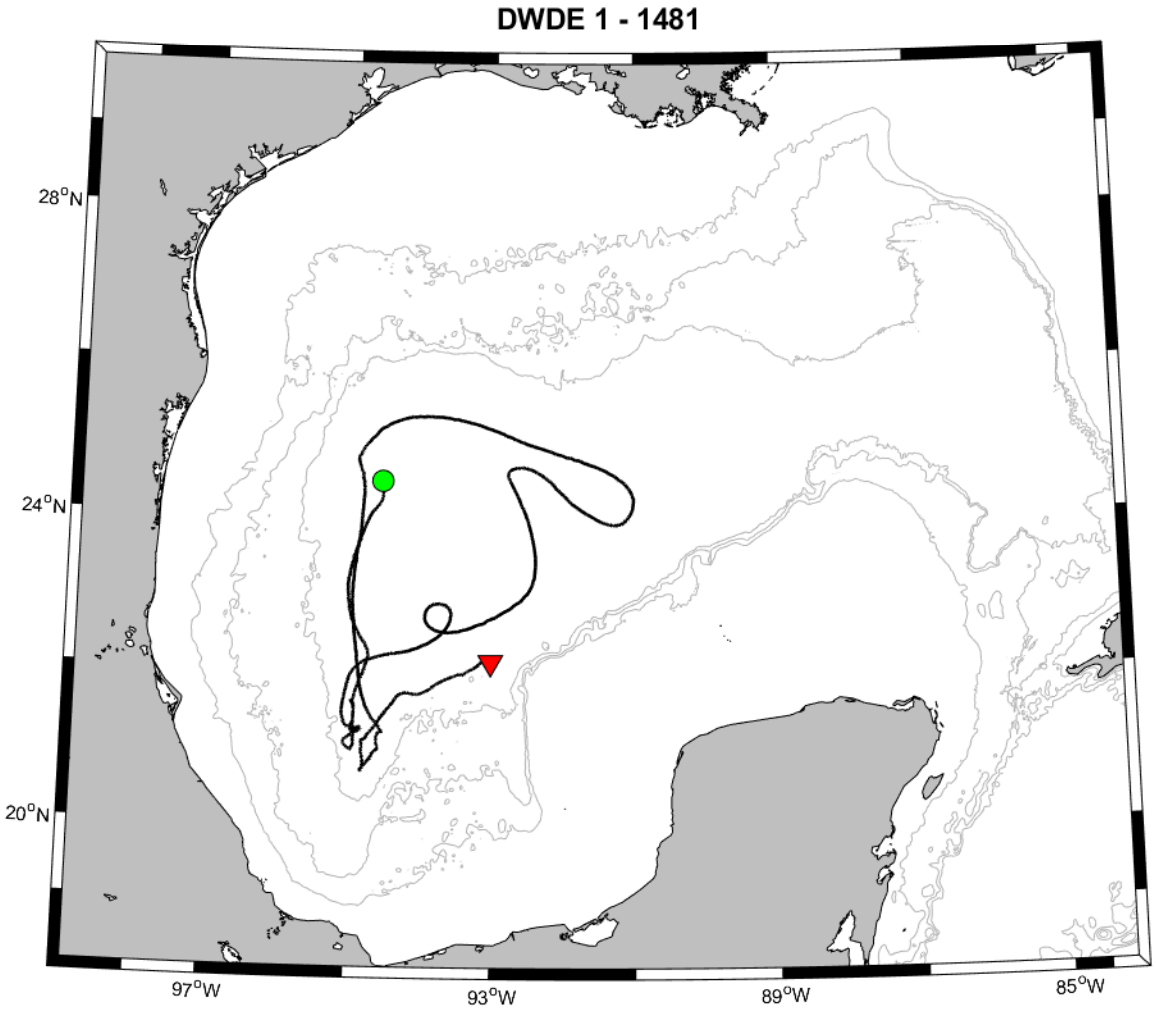

Float 1479 DWDE 2 (1500-dbar)
temperature (℃)
4.48
4.3
4.12
pressure (db)
1320
1420
1520
u-velocity (cm/s)
20
0
-20
v-velocity (cm/s)
20
0
-20
u-v velocity (cm/s)
20
0
-20
Nov 2016
Jan 2017
Mar 2017
May 2017
Jul 2017
Sep 2017
Nov 2017
Jan 2018
Mar 2018

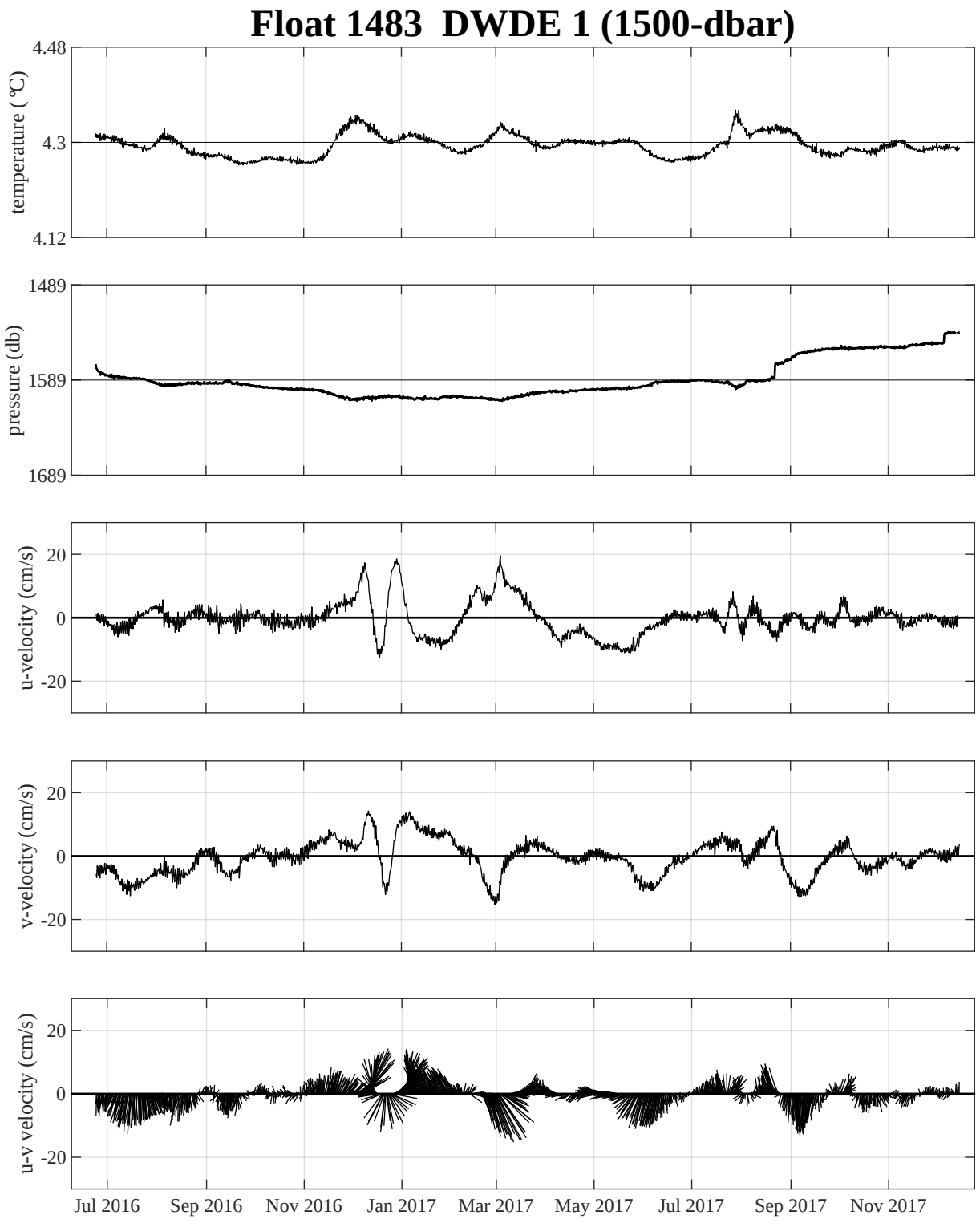

DWDE 2 - 1479
28°N
24°N
20°N
97°W
93°W
89°W
85°W

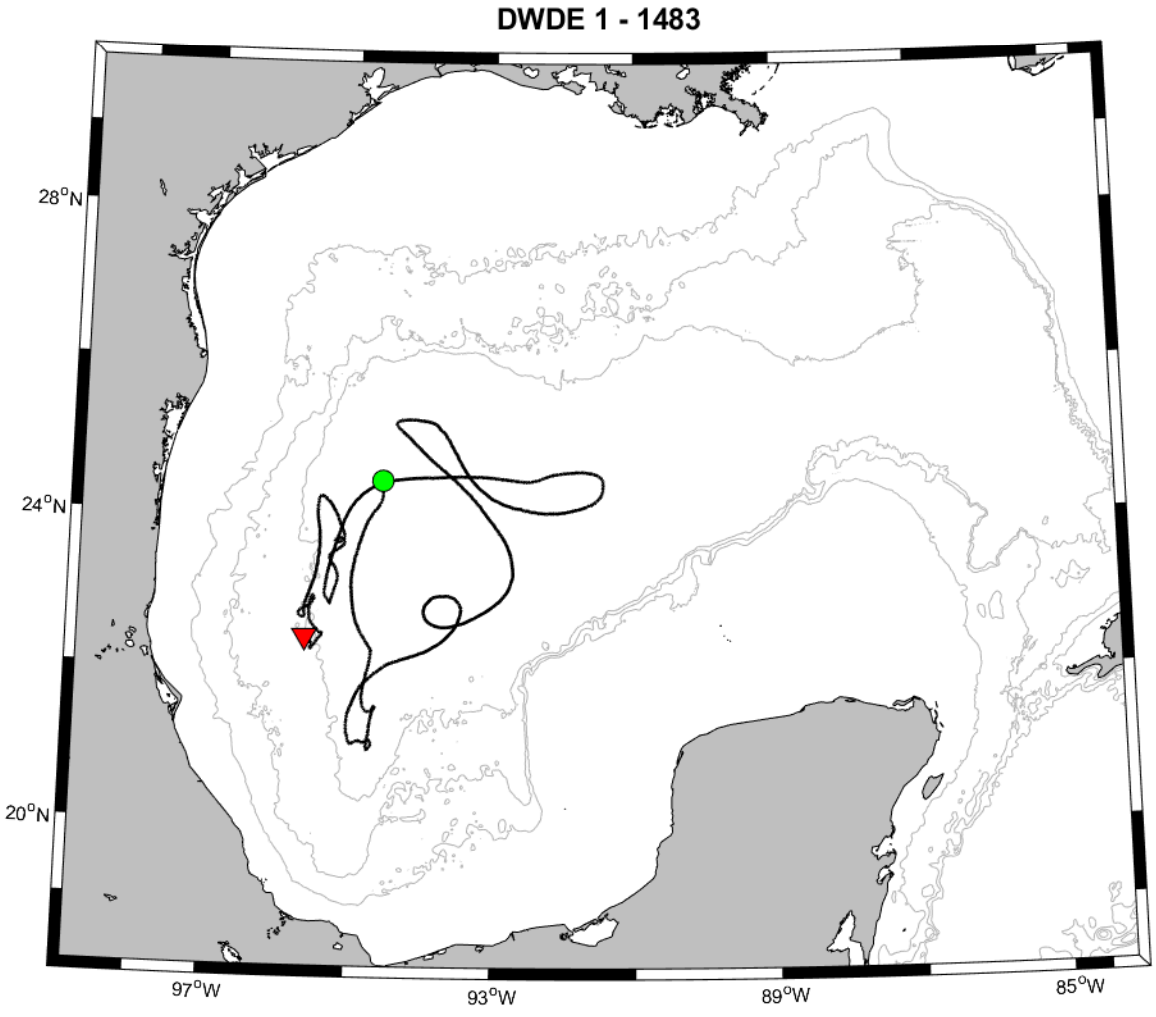

Float 1480 DWDE 1 (1500-dbar)
temperature (℃)
4.48
4.3
4.12
pressure (db)
1464
1564
1664
u-velocity (cm/s)
20
0
-20
v-velocity (cm/s)
20
0
-20
u-v velocity (cm/s)
20
0
-20
Jul 2016
Sep 2016
Nov 2016
Jan 2017
Mar 2017
May 2017
Jul 2017
Sep 2017
Nov 2017

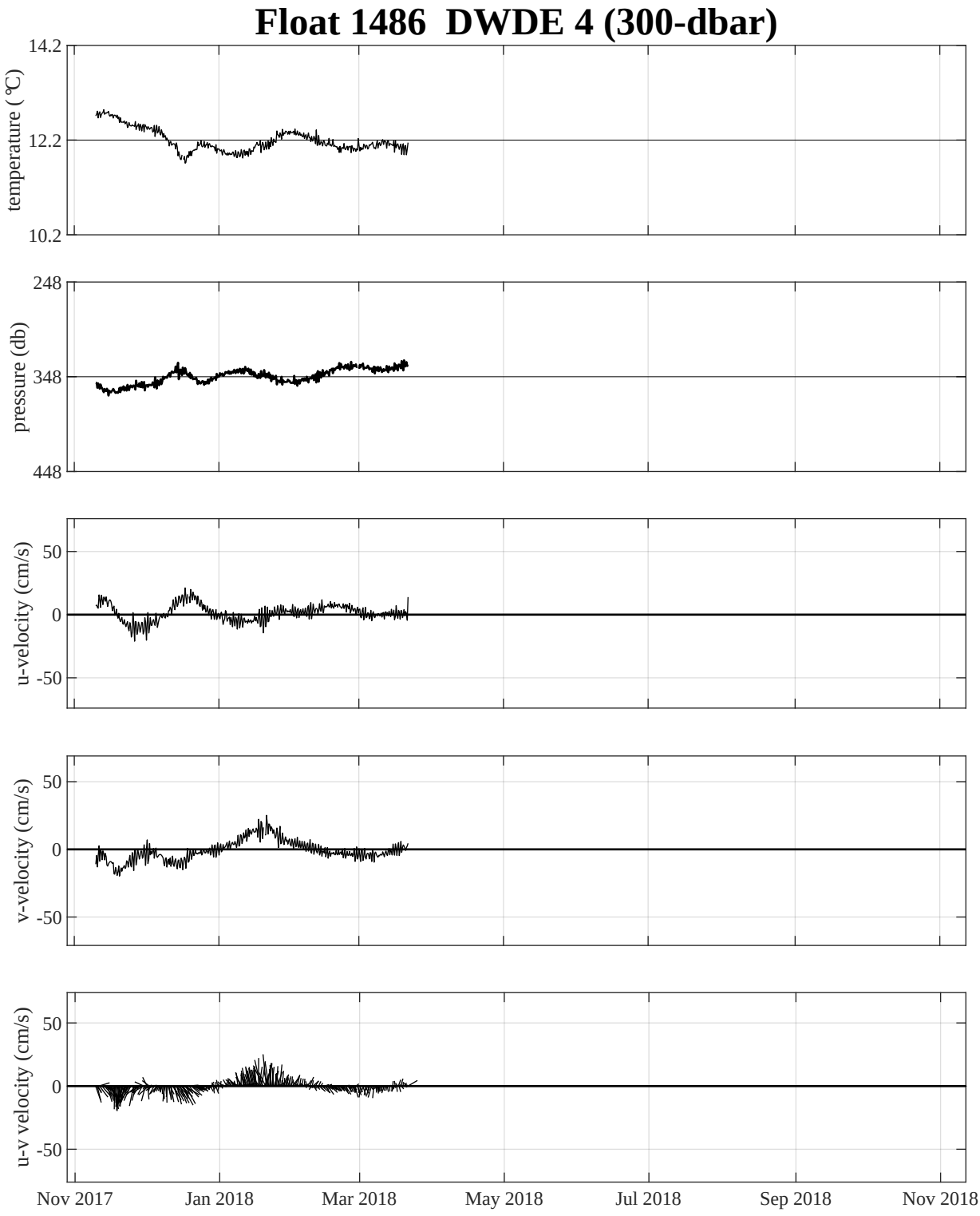

DWDE 1 - 1480
28°N
24°N
20°N
97°W
93°W
89°W
85°W

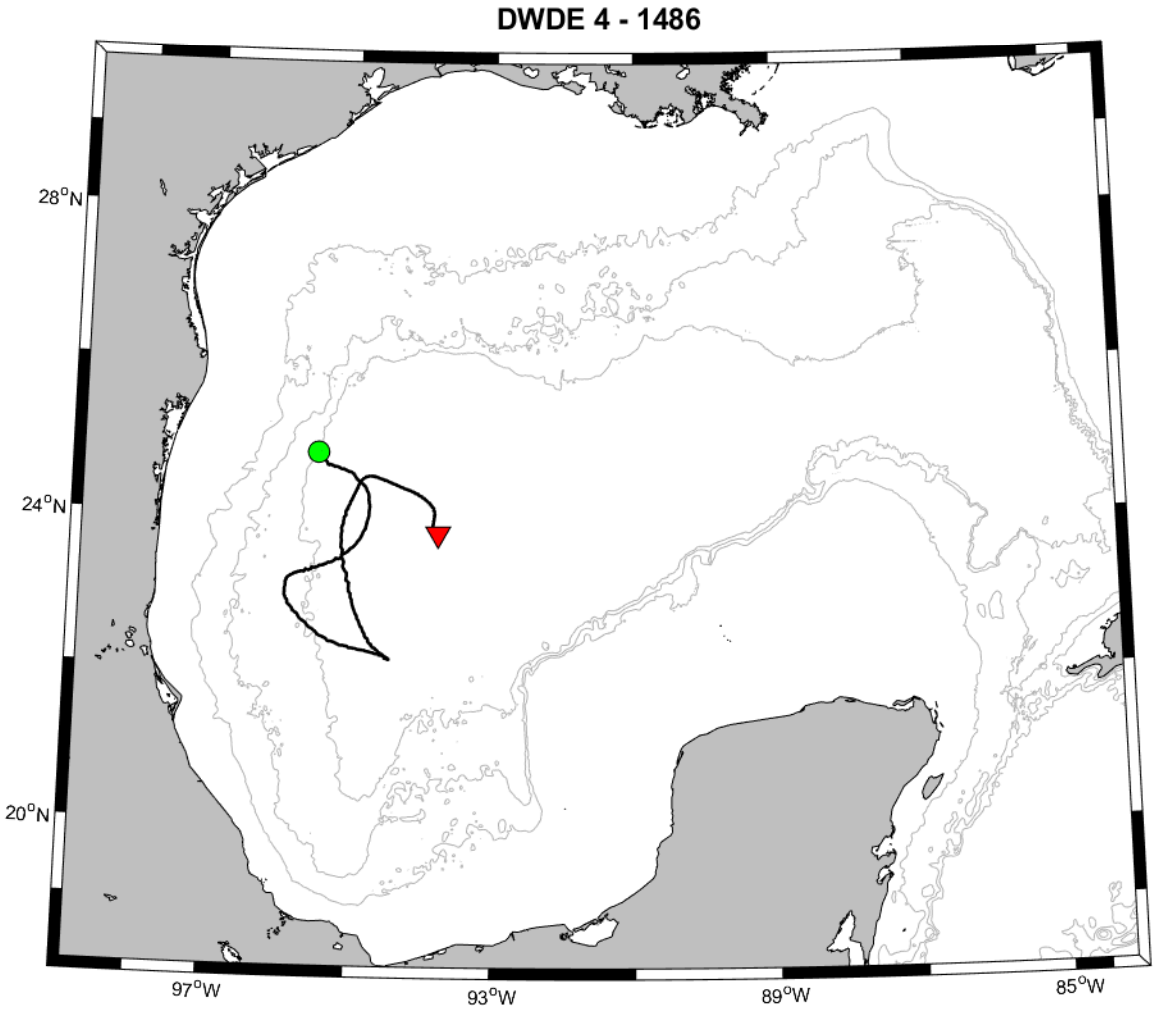

Float 1481 DWDE 1 (1500-dbar)
temperature (℃)
4.48
4.3
4.12
pressure (db)
1456
1556
1656
u-velocity (cm/s)
20
0
-20
v-velocity (cm/s)
20
0
-20
u-v velocity (cm/s)
20
0
-20
Jul 2016
Sep 2016
Nov 2016
Jan 2017
Mar 2017
May 2017
Jul 2017
Sep 2017
Nov 2017

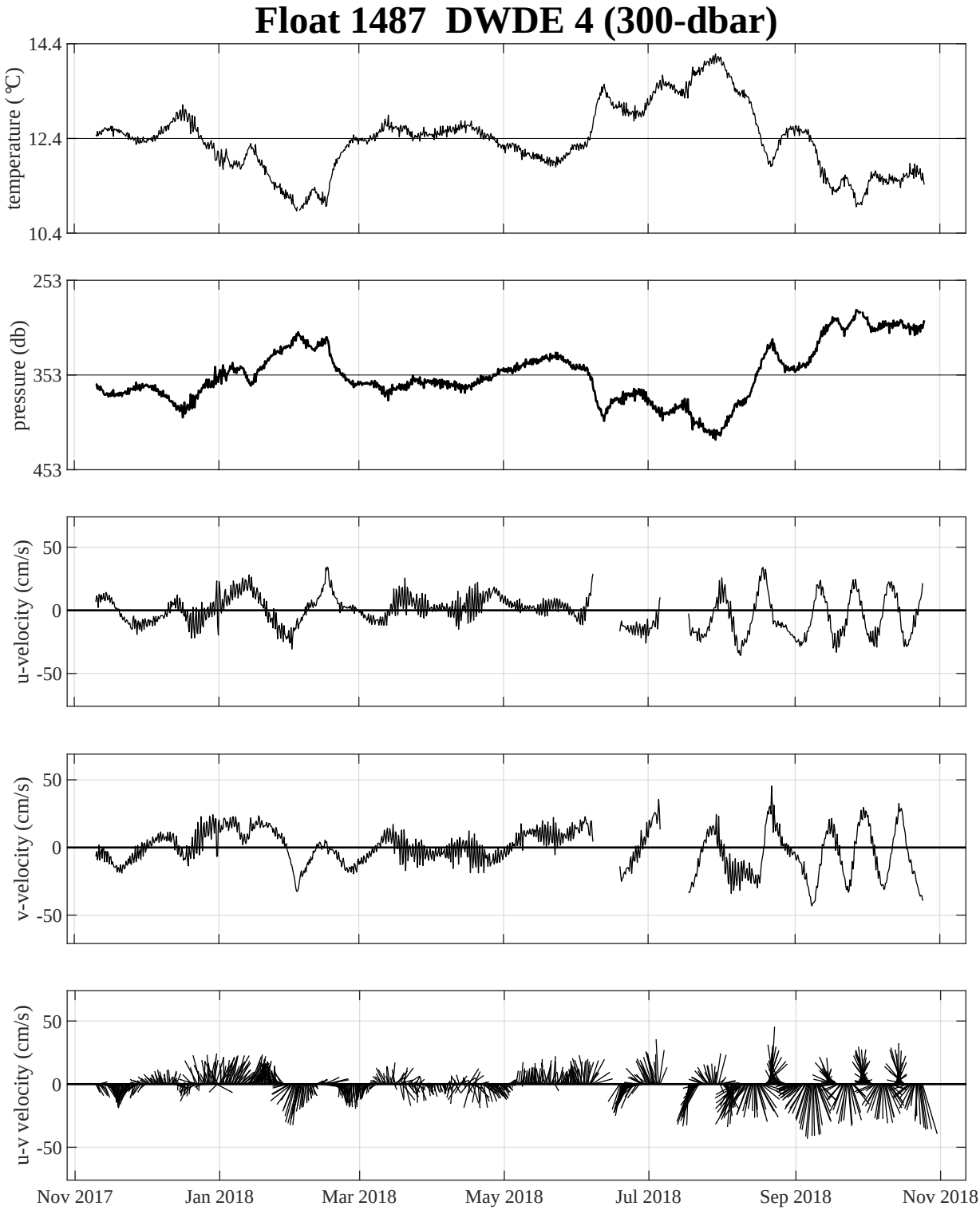

DWDE 1 - 1481
28°N
24°N
20°N
97°W
93°W
89°W
85°W

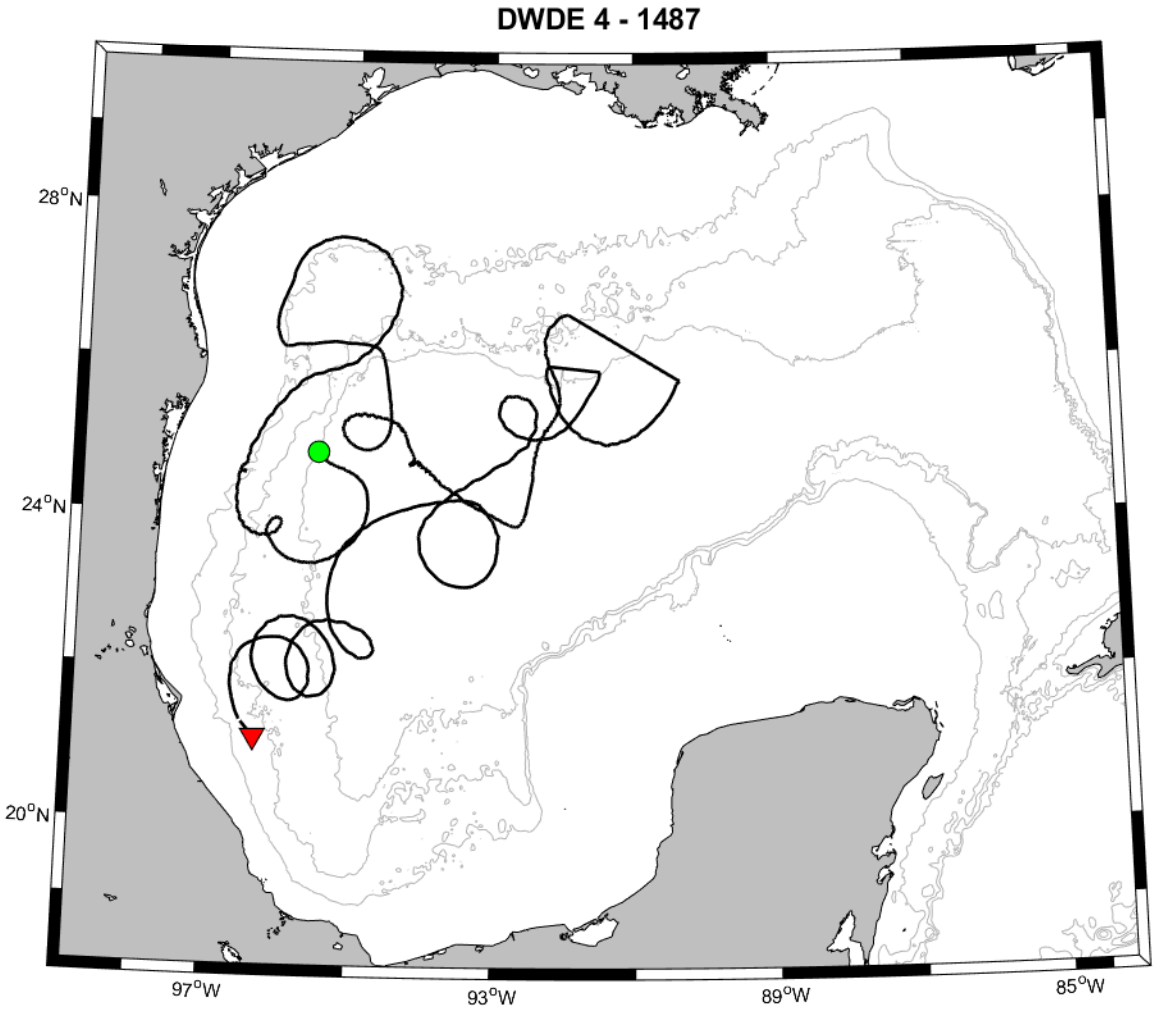

Float 1483 DWDE 1 (1500-dbar)
temperature (℃)
4.48
4.3
4.12
pressure (db)
1489
1589
1689
u-velocity (cm/s)
20
0
-20
v-velocity (cm/s)
20
0
-20
u-v velocity (cm/s)
20
0
-20
Jul 2016
Sep 2016
Nov 2016
Jan 2017
Mar 2017
May 2017
Jul 2017
Sep 2017
Nov 2017

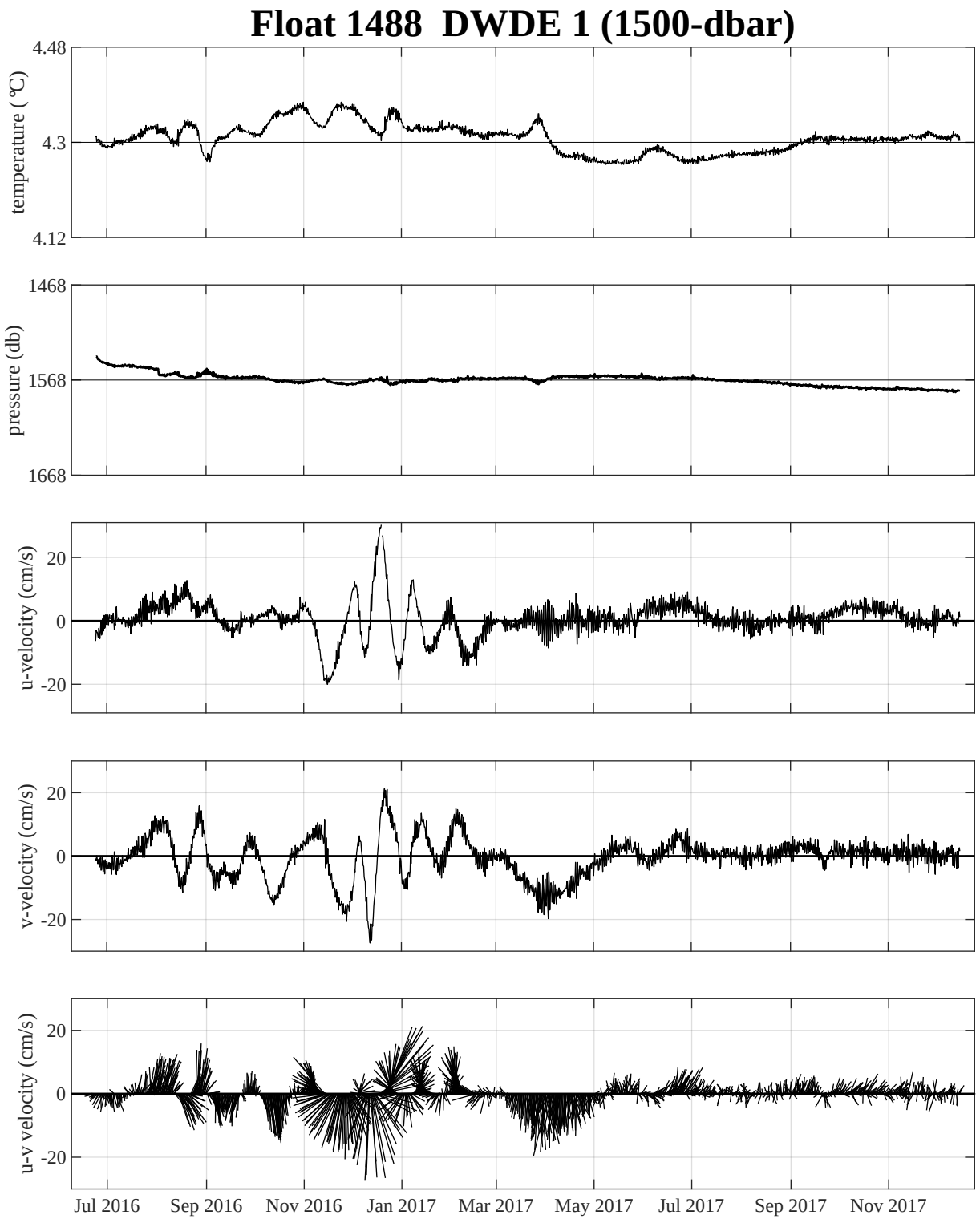

DWDE 1 - 1483
28°N
24°N
20°N
97°W
93°W
89°W
85°W

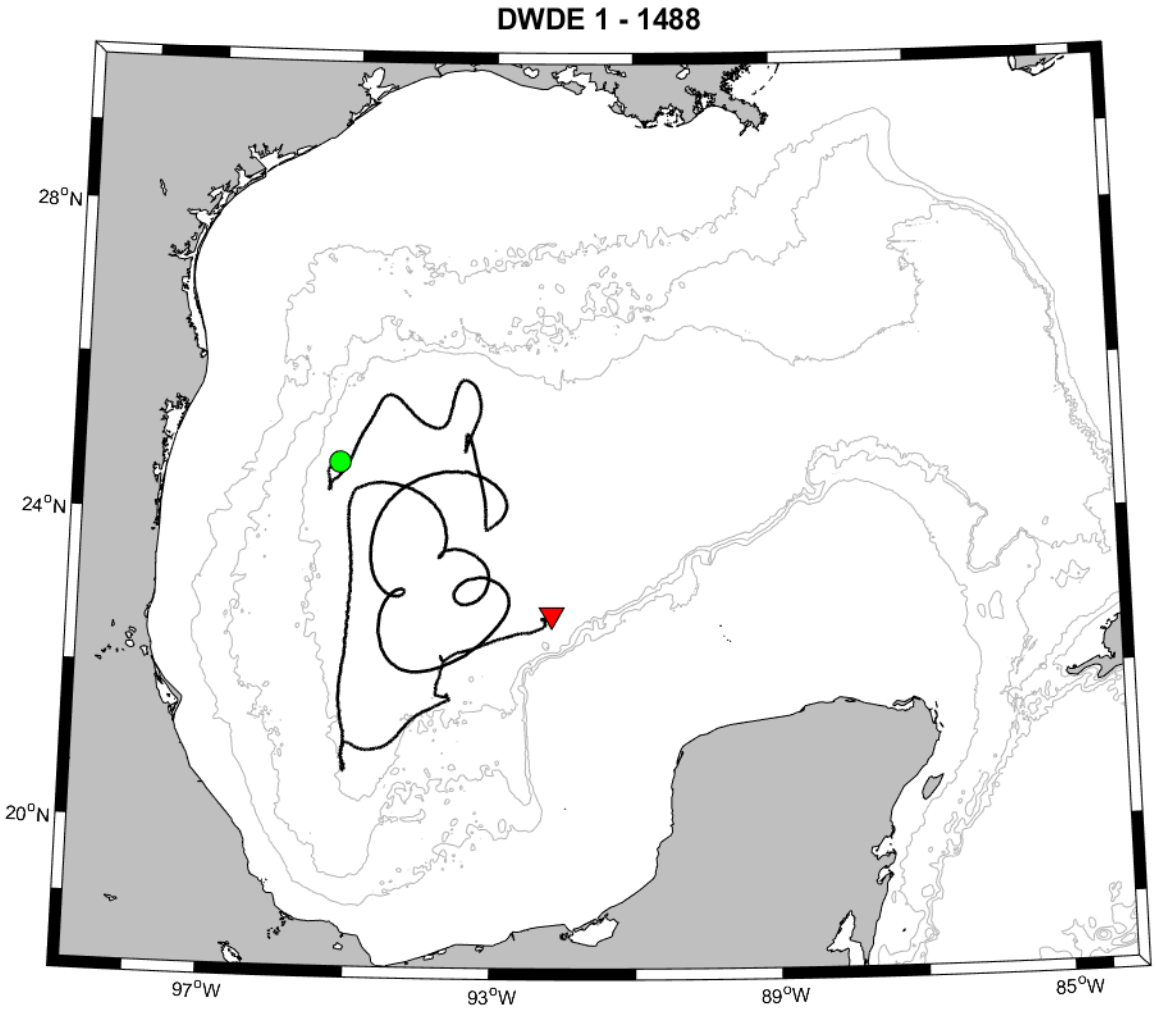

Float 1486 DWDE 4 (300-dbar)
temperature (℃)
14.2
12.2
10.2
pressure (db)
248
348
448
u-velocity (cm/s)
50
0
-50
v-velocity (cm/s)
50
0
-50
u-v velocity (cm/s)
50
0
-50
Nov 2017
Jan 2018
Mar 2018
May 2018
Jul 2018
Sep 2018
Nov 2018

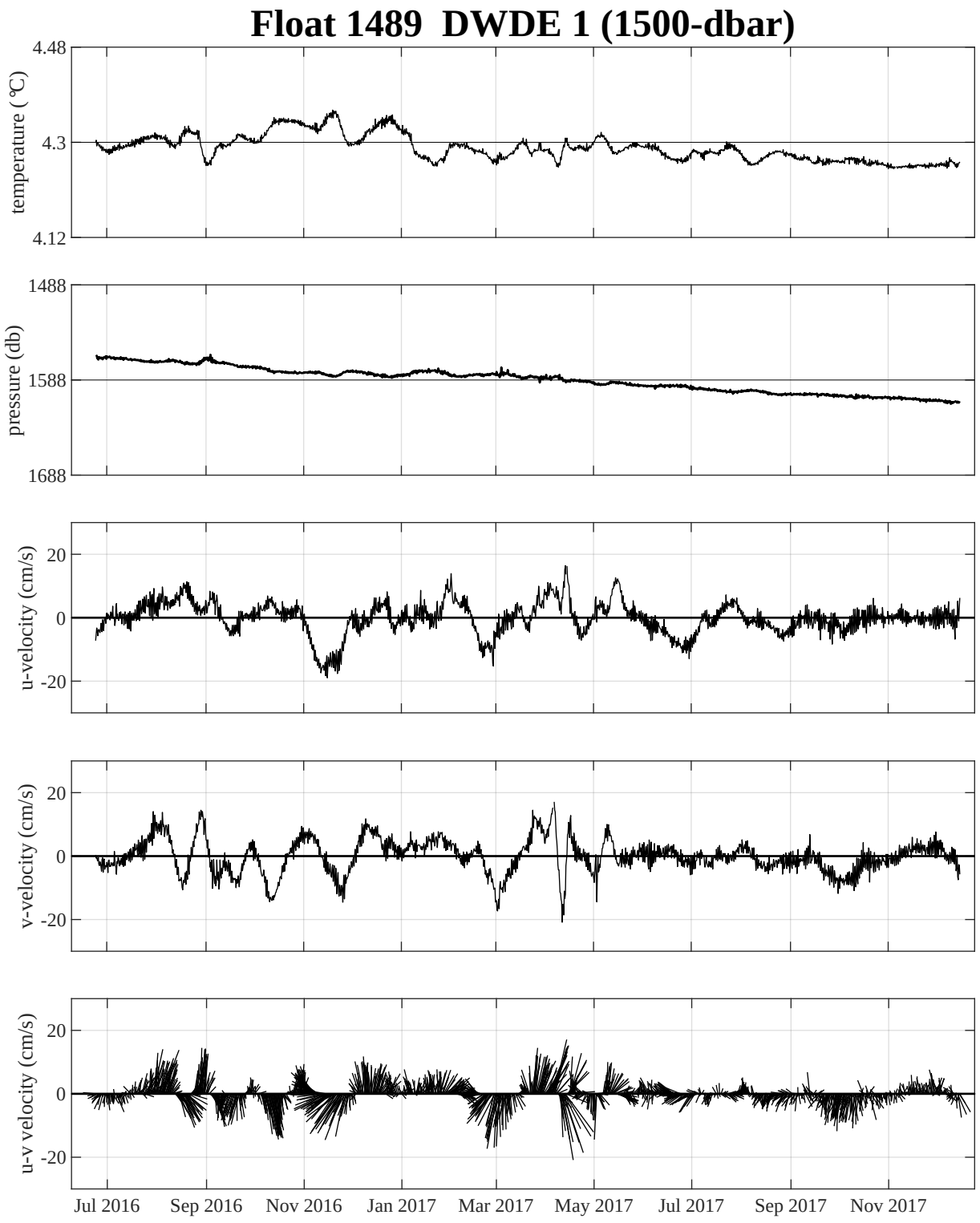

DWDE 4 - 1486
28°N
24°N
20°N
97°W
93°W
89°W
85°W

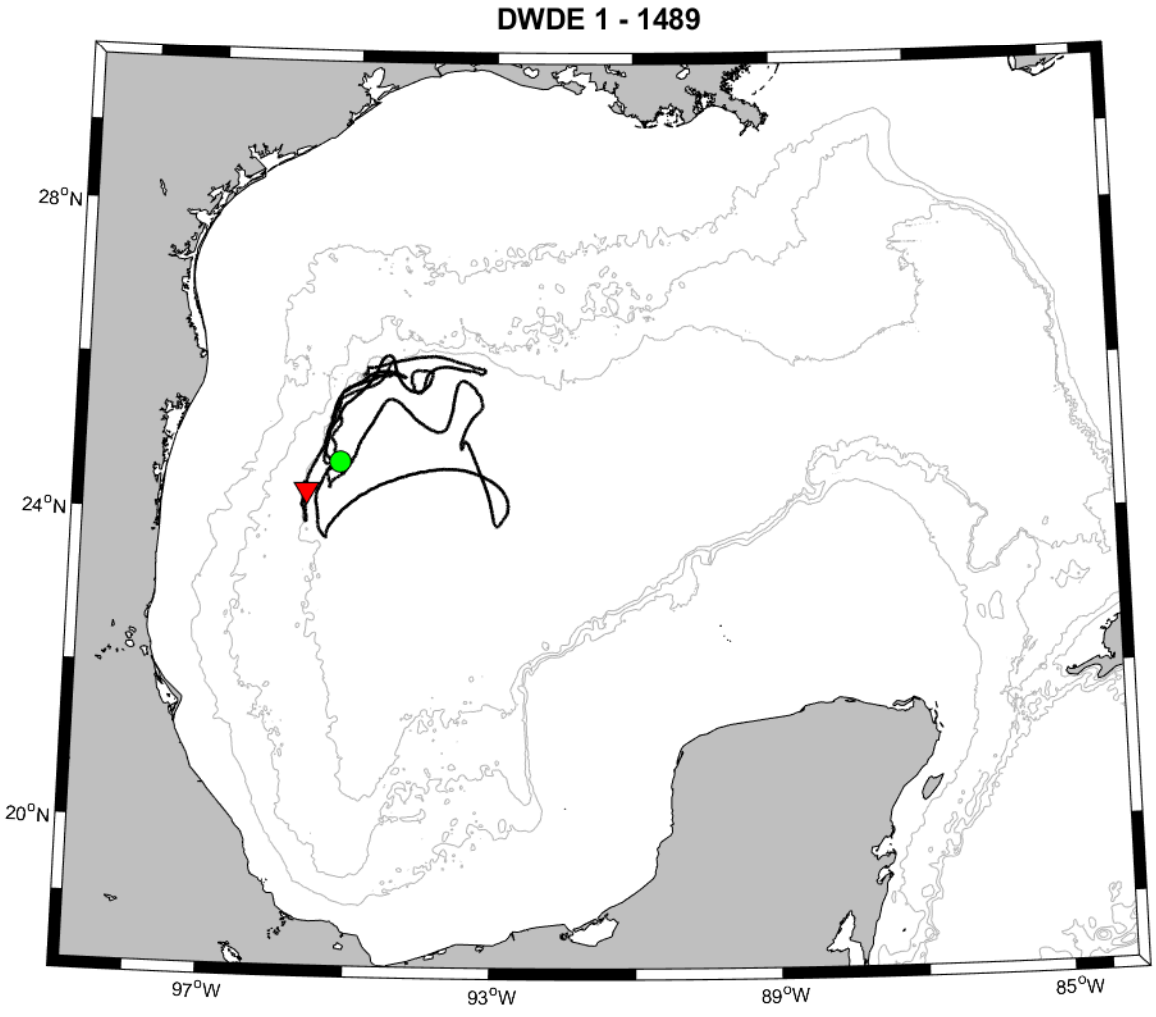

Float 1487 DWDE 4 (300-dbar)
temperature (℃)
14.4
12.4
10.4
pressure (db)
253
353
453
u-velocity (cm/s)
50
0
-50
v-velocity (cm/s)
50
0
-50
u-v velocity (cm/s)
50
0
-50
Nov 2017
Jan 2018
Mar 2018
May 2018
Jul 2018
Sep 2018
Nov 2018

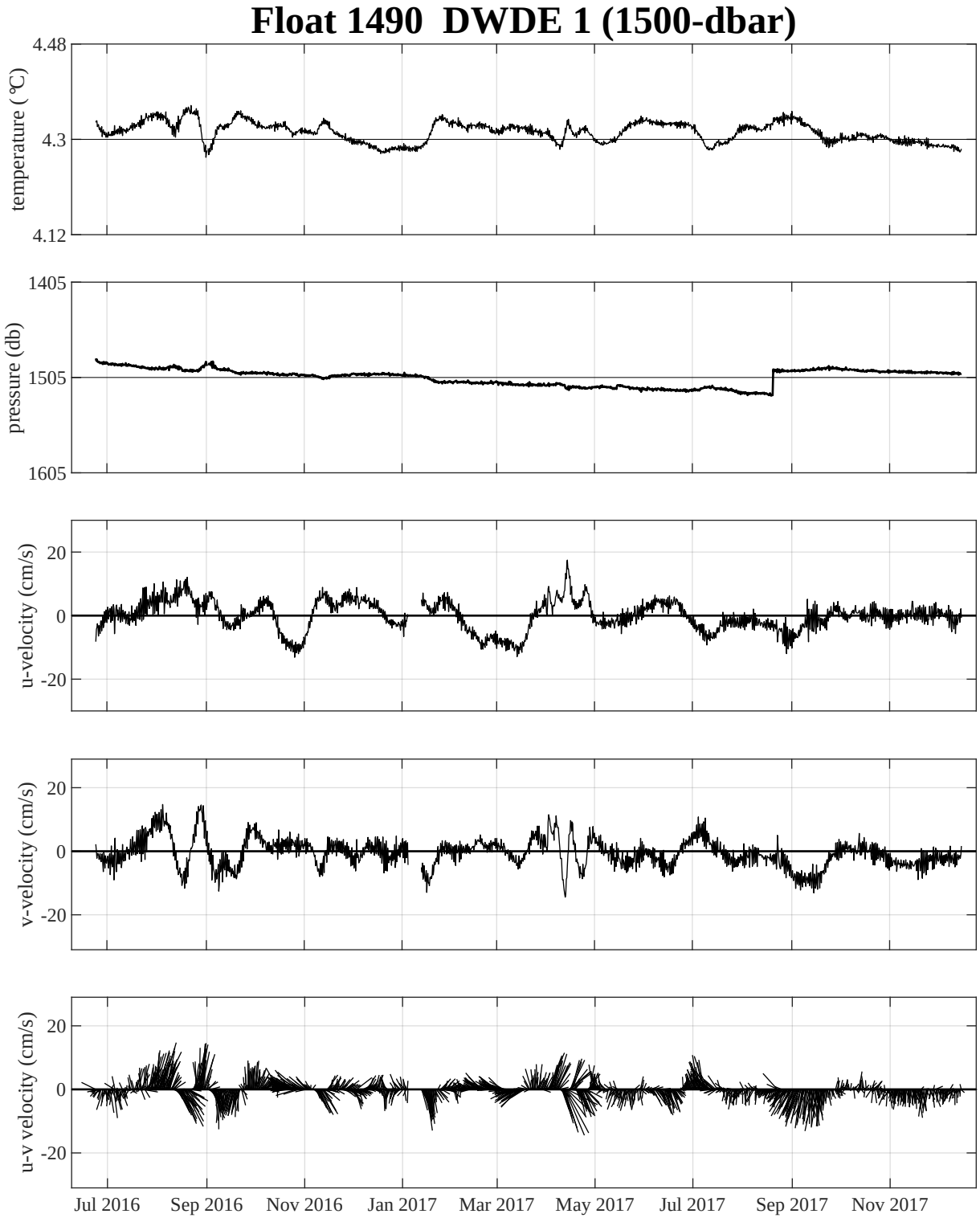

DWDE 4 - 1487
28°N
24°N
20°N
97°W
93°W
89°W
85°W

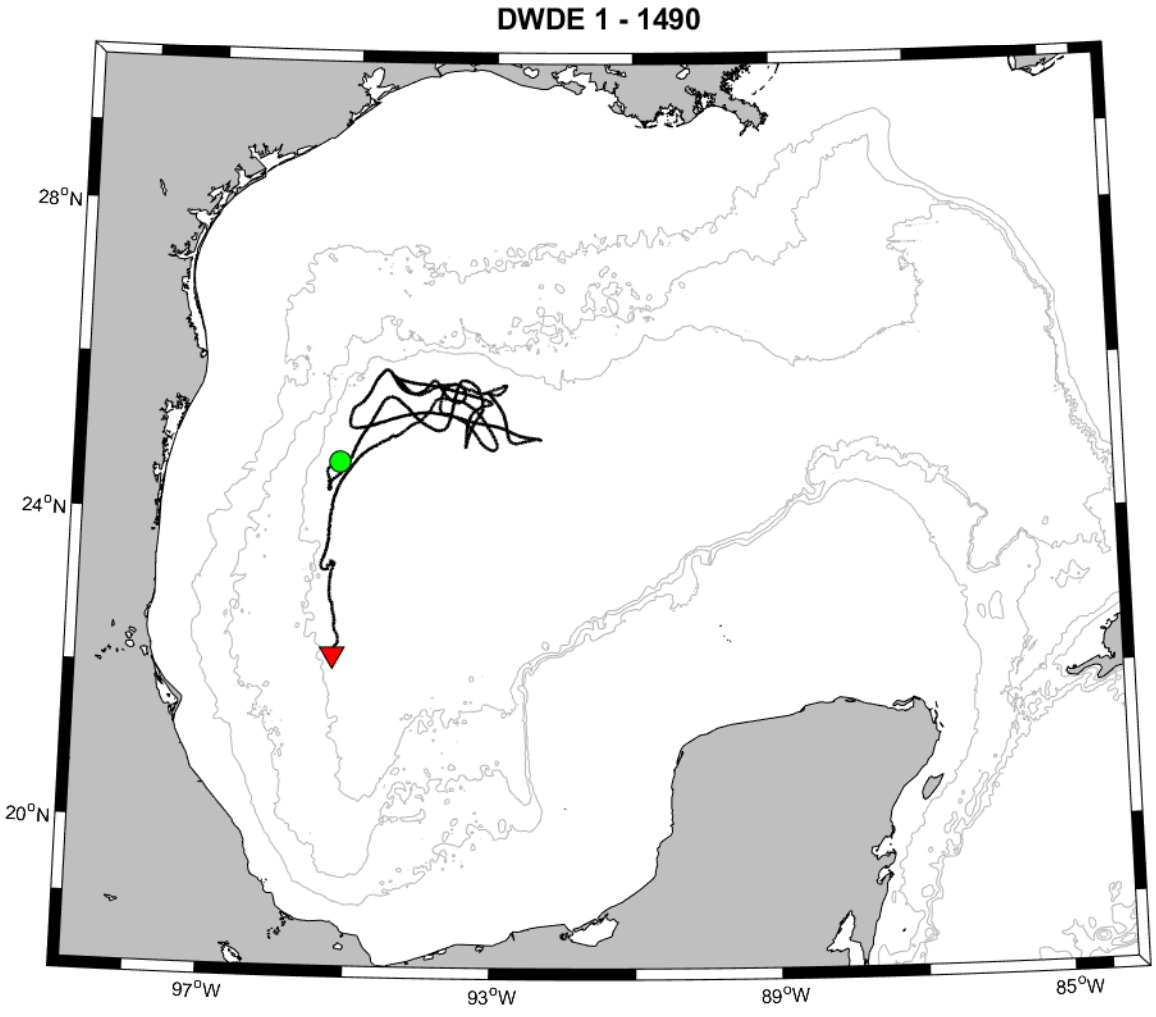

Float 1488 DWDE 1 (1500-dbar)
temperature (℃)
4.48
4.3
4.12
pressure (db)
1468
1568
1668
u-velocity (cm/s)
20
0
-20
v-velocity (cm/s)
20
0
-20
u-v velocity (cm/s)
20
0
-20
Jul 2016
Sep 2016
Nov 2016
Jan 2017
Mar 2017
May 2017
Jul 2017
Sep 2017
Nov 2017

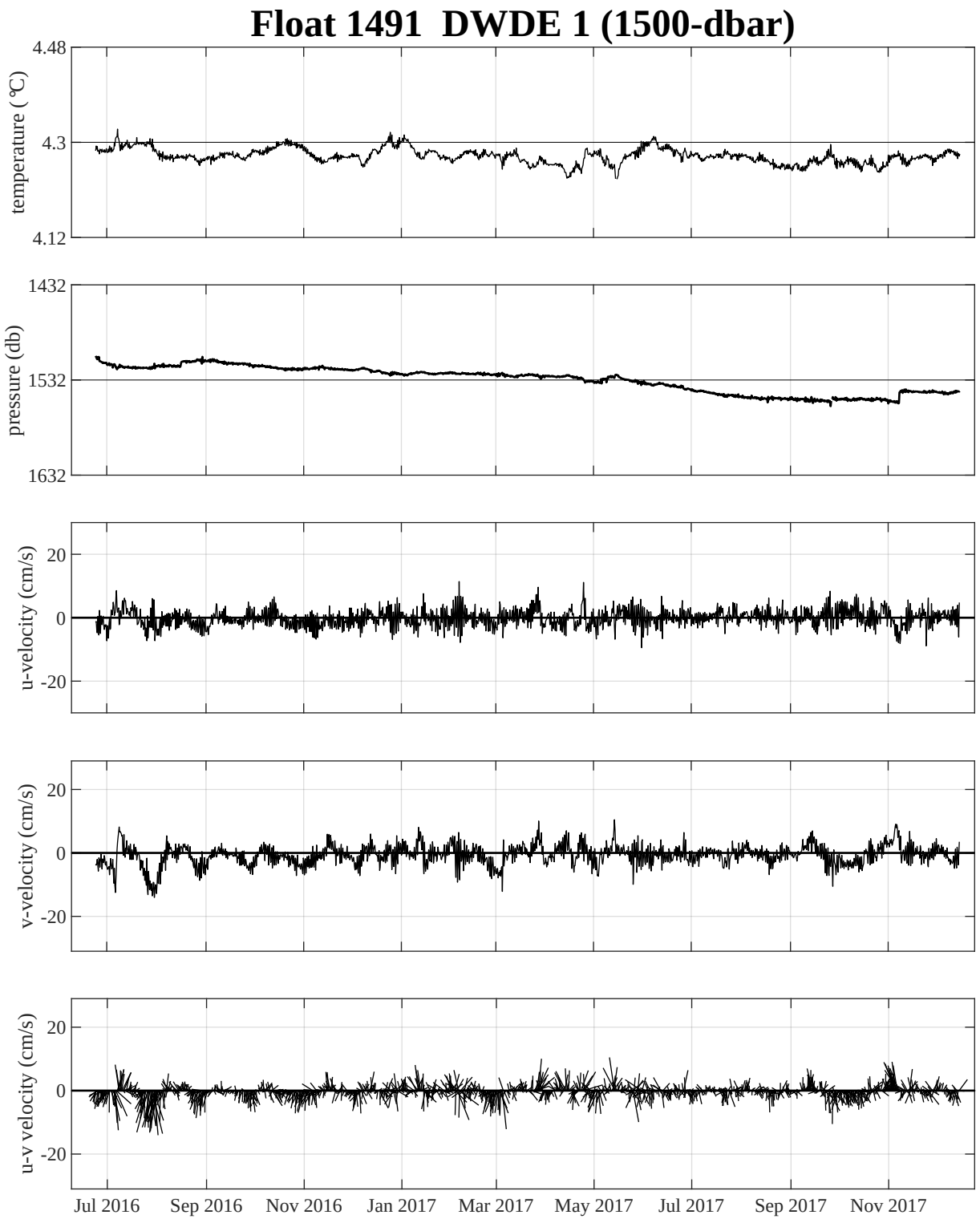

DWDE 1 - 1488
28°N
24°N
20°N
97°W
93°W
89°W
85°W

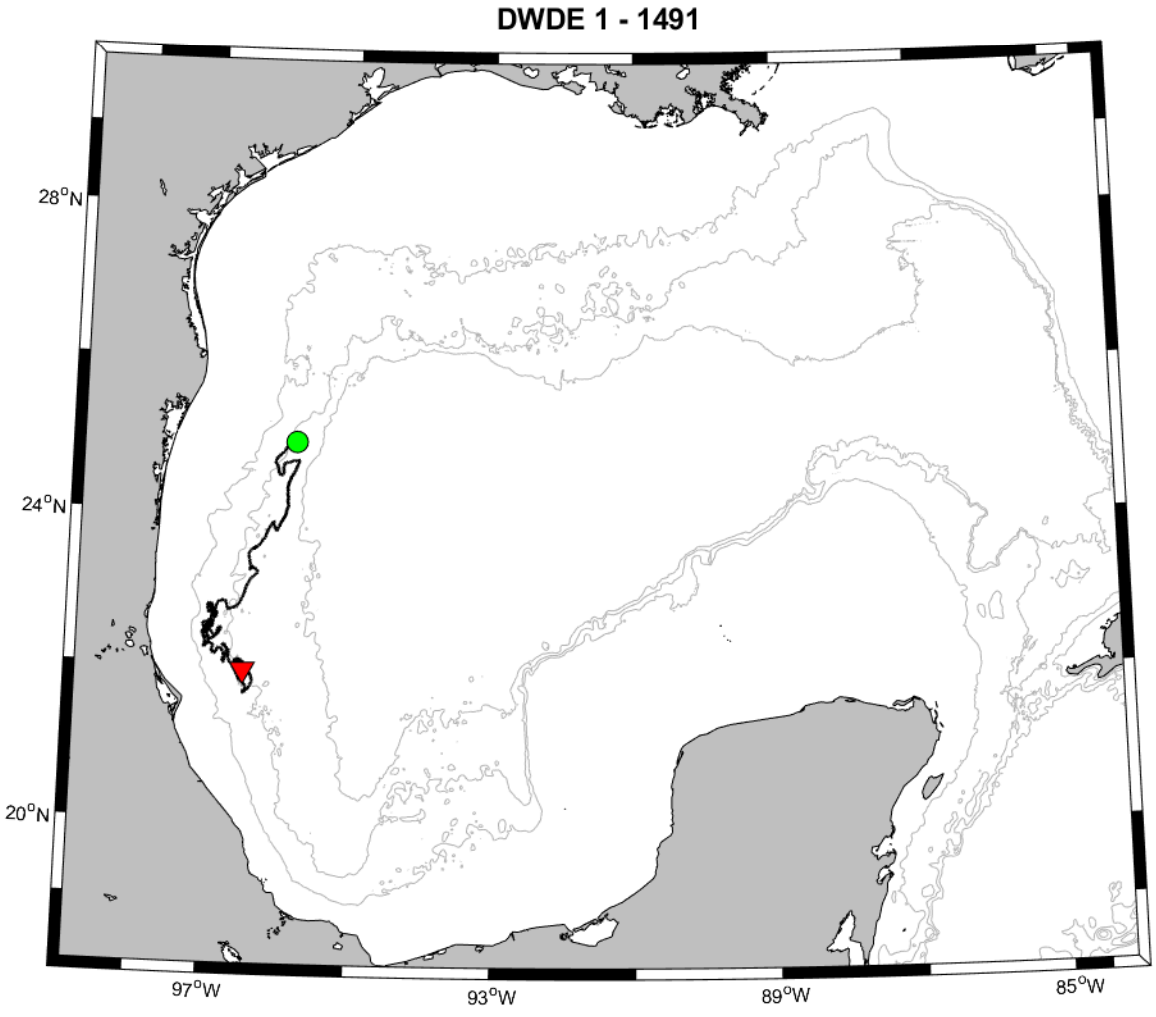

Float 1489 DWDE 1 (1500-dbar)
temperature (℃)
4.48
4.3
4.12
pressure (db)
1488
1588
1688
u-velocity (cm/s)
20
0
-20
v-velocity (cm/s)
20
0
-20
u-v velocity (cm/s)
20
0
-20
Jul 2016
Sep 2016
Nov 2016
Jan 2017
Mar 2017
May 2017
Jul 2017
Sep 2017
Nov 2017

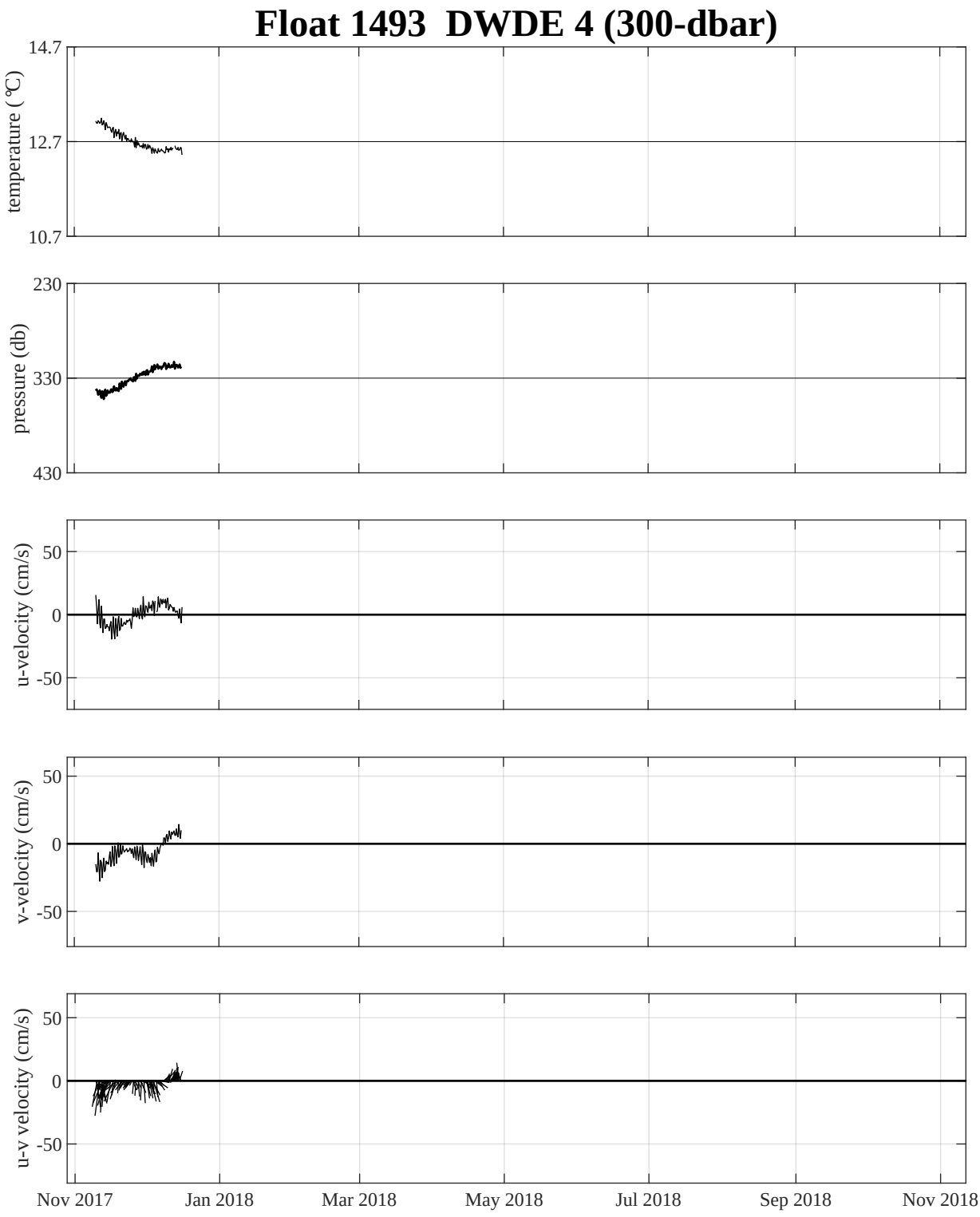

DWDE 1 - 1489
28°N
24°N
20°N
97°W
93°W
89°W
85°W

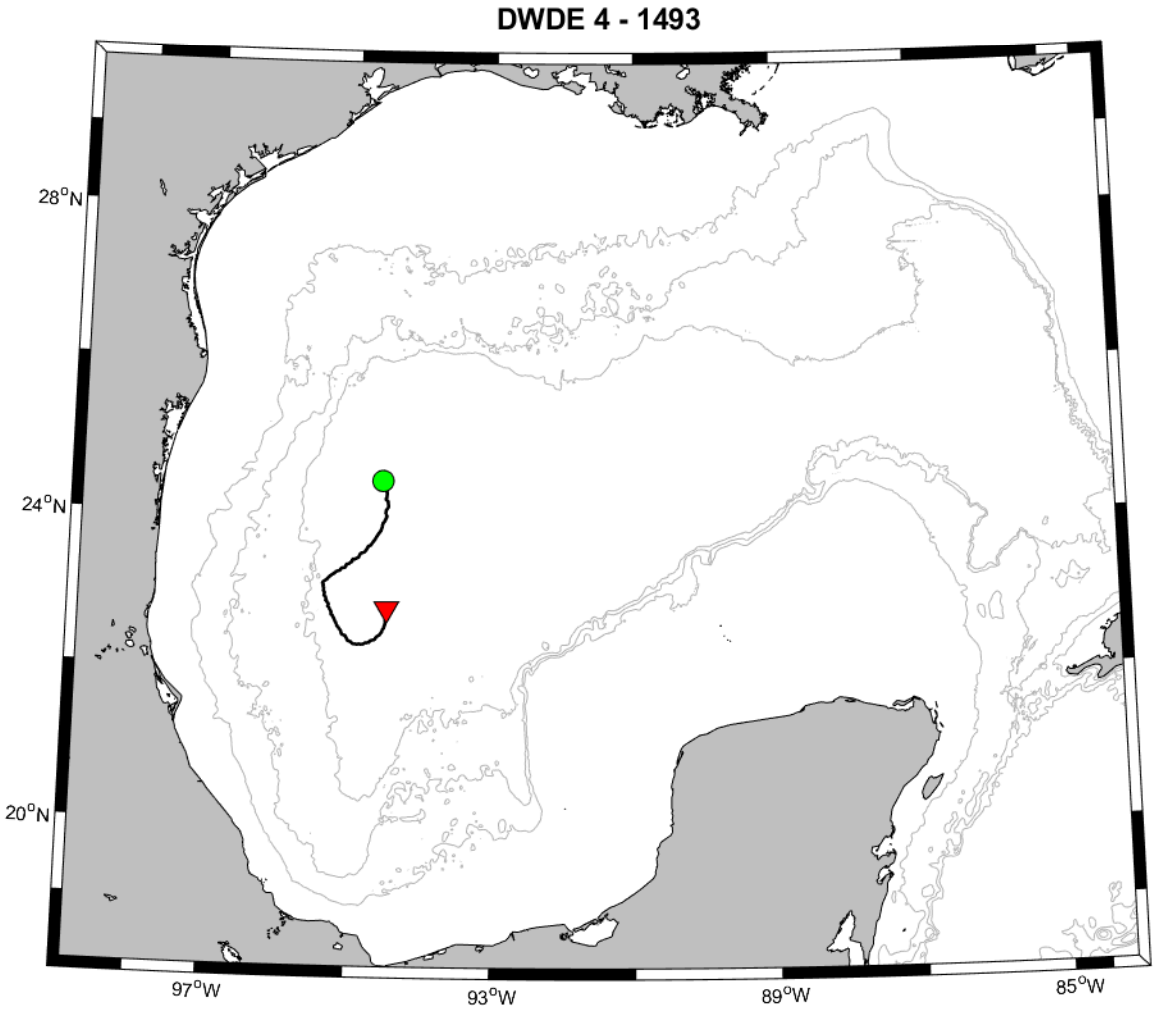

Float 1490 DWDE 1 (1500-dbar)
temperature (℃)
4.48
4.3
4.12
pressure (db)
1405
1505
1605
u-velocity (cm/s)
20
0
-20
v-velocity (cm/s)
20
0
-20
u-v velocity (cm/s)
20
0
-20
Jul 2016
Sep 2016
Nov 2016
Jan 2017
Mar 2017
May 2017
Jul 2017
Sep 2017
Nov 2017

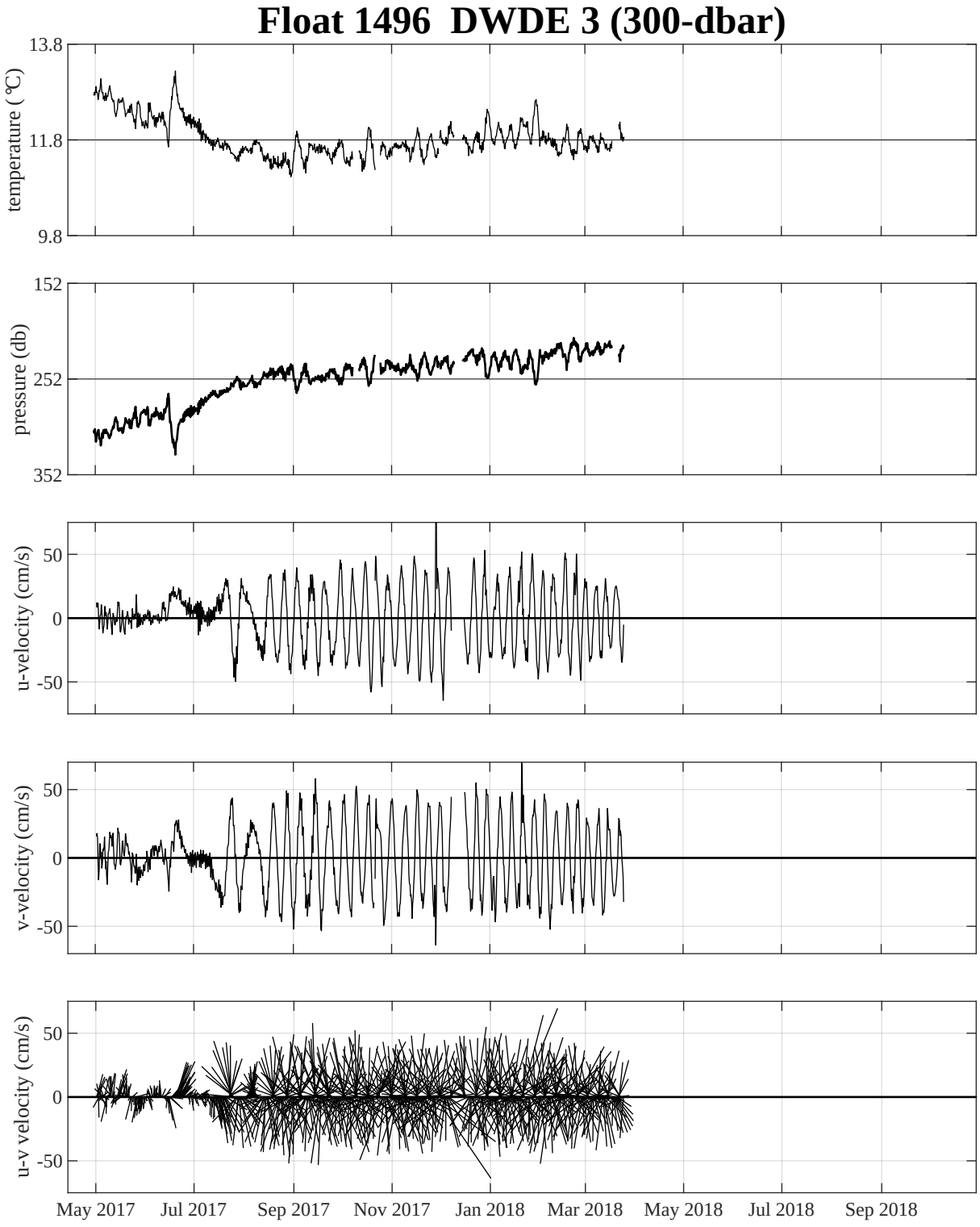

DWDE 1 - 1490
28°N
24°N
20°N
97°W
93°W
89°W
85°W

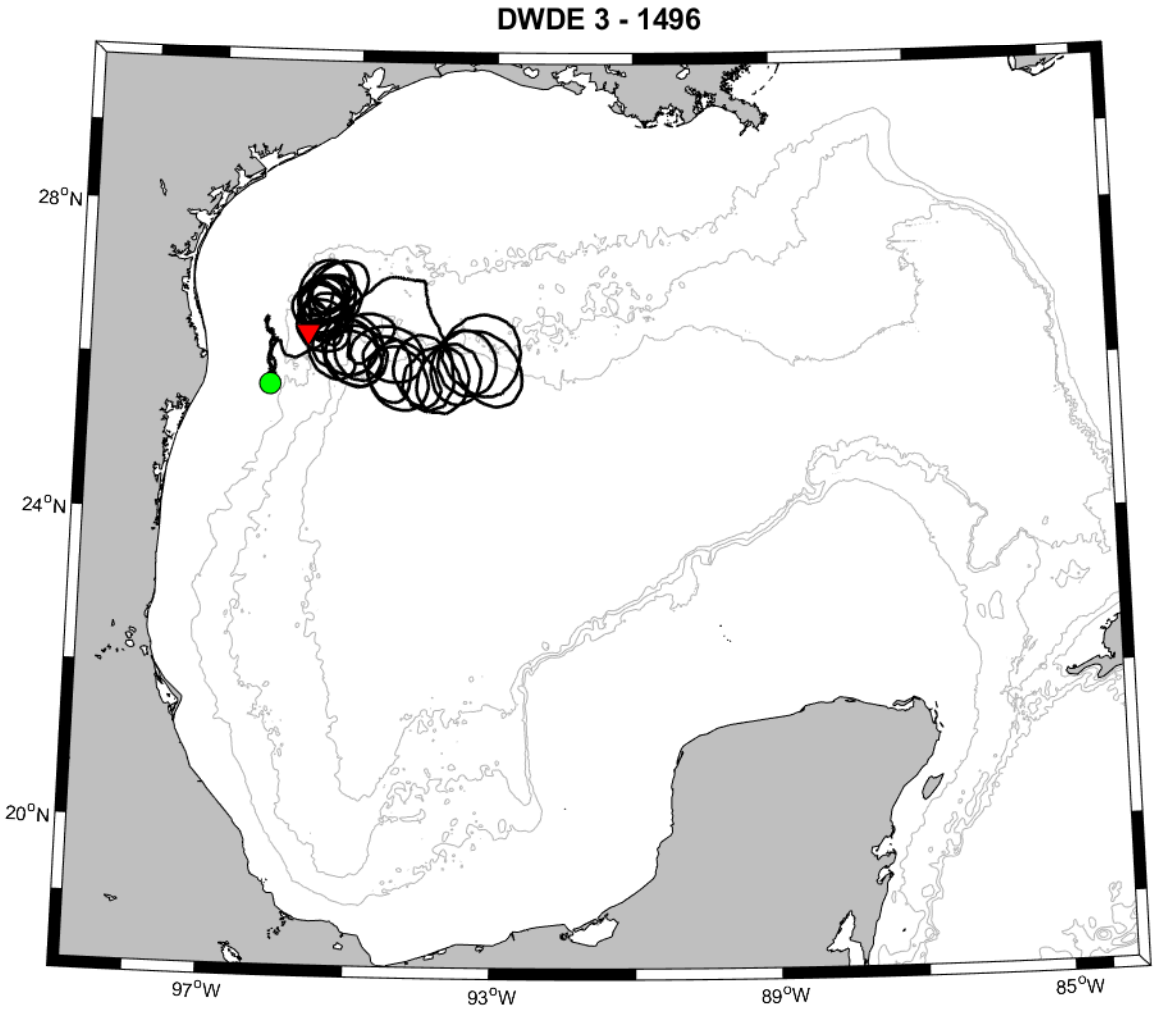

Float 1491 DWDE 1 (1500-dbar)
temperature (℃)
4.48
4.3
4.12
pressure (db)
1432
1532
1632
u-velocity (cm/s)
20
0
-20
v-velocity (cm/s)
20
0
-20
u-v velocity (cm/s)
20
0
-20
Jul 2016
Sep 2016
Nov 2016
Jan 2017
Mar 2017
May 2017
Jul 2017
Sep 2017
Nov 2017

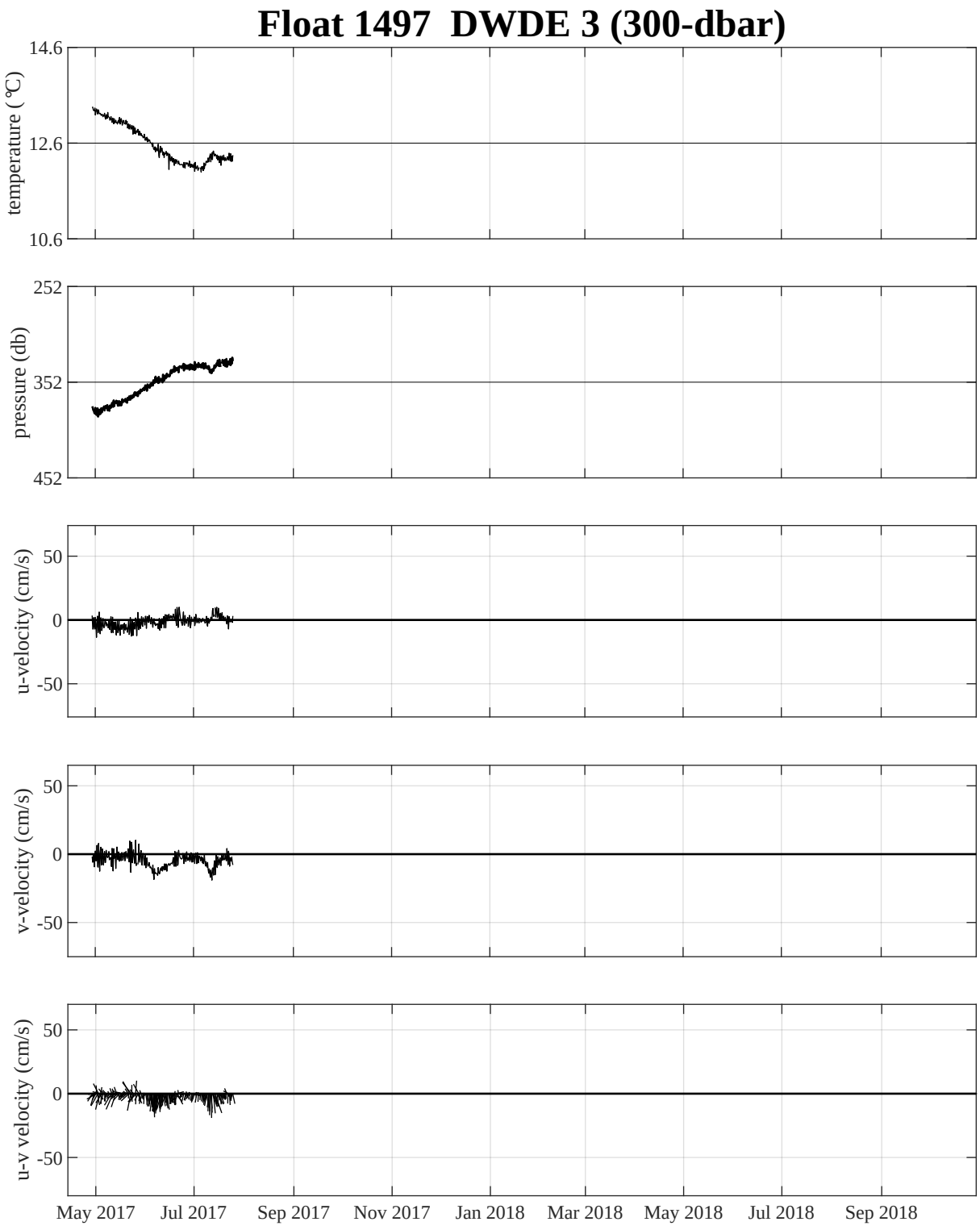

DWDE 1 - 1491
28°N
24°N
20°N
97°W
93°W
89°W
85°W

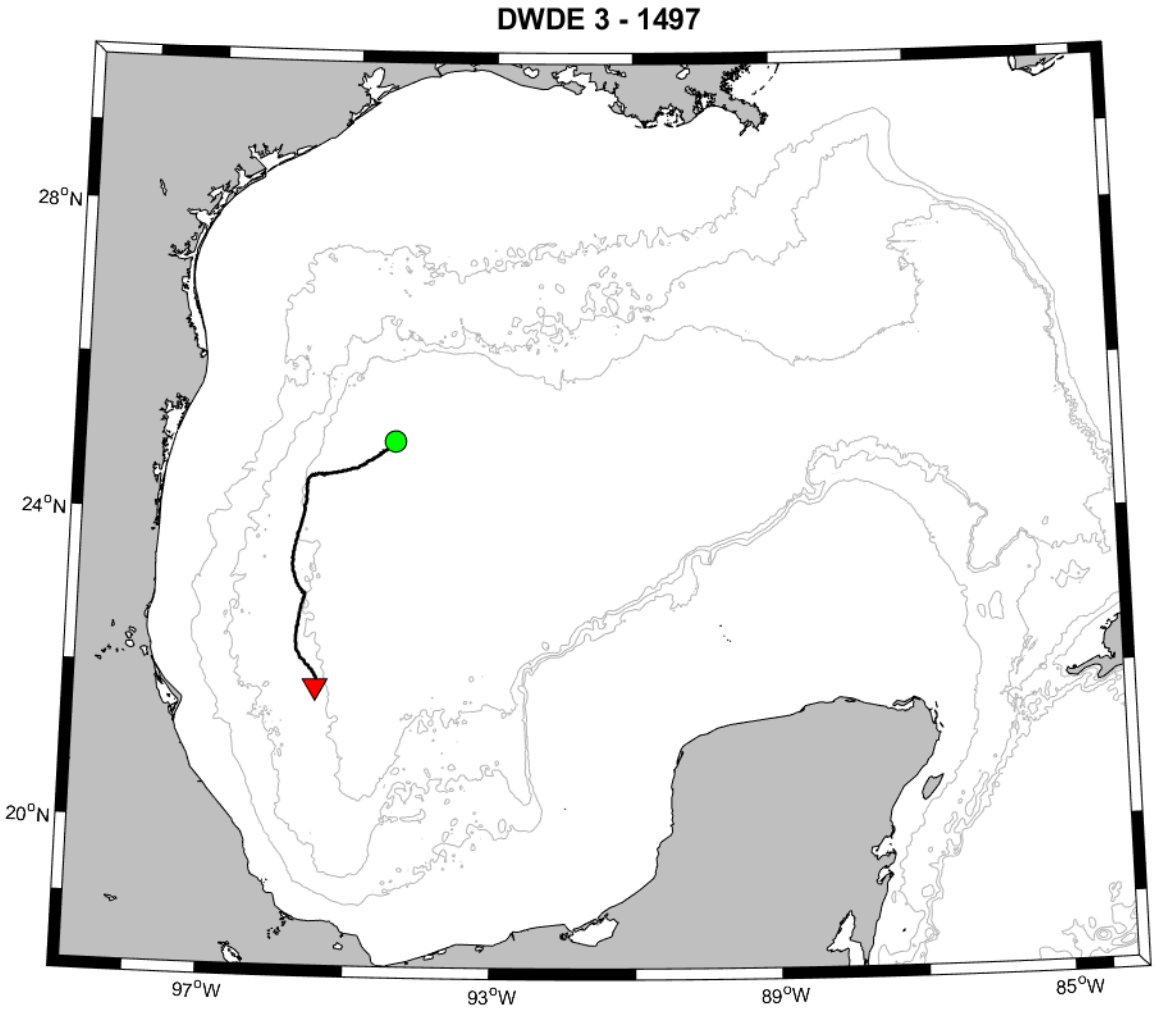

Float 1493 DWDE 4 (300-dbar)
temperature (℃)
14.7
12.7
10.7
pressure (db)
230
330
430
u-velocity (cm/s)
50
0
-50
v-velocity (cm/s)
50
0
-50
u-v velocity (cm/s)
50
0
-50
Nov 2017
Jan 2018
Mar 2018
May 2018
Jul 2018
Sep 2018
Nov 2018

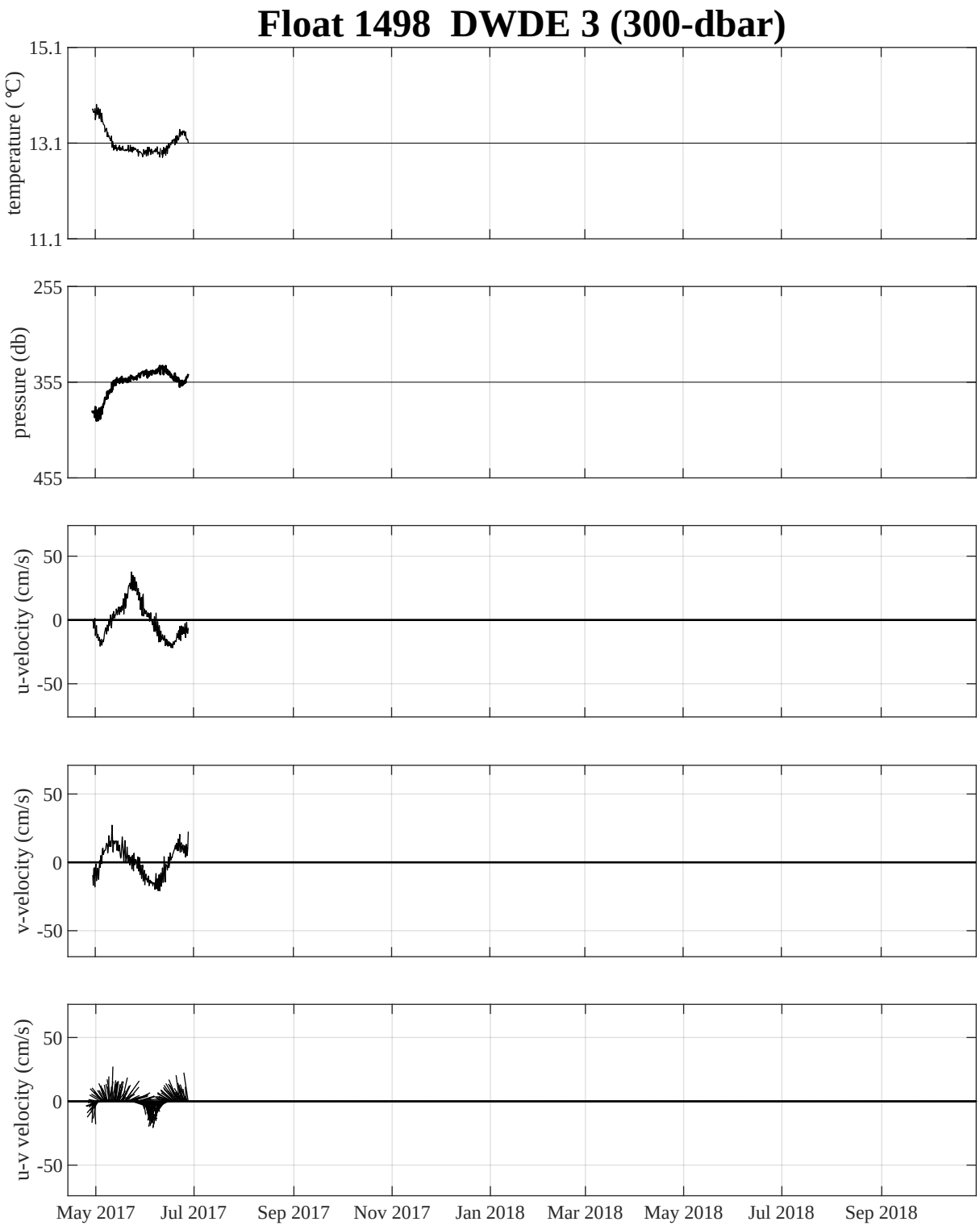

DWDE 4 - 1493
28°N
24°N
20°N
97°W
93°W
89°W
85°W

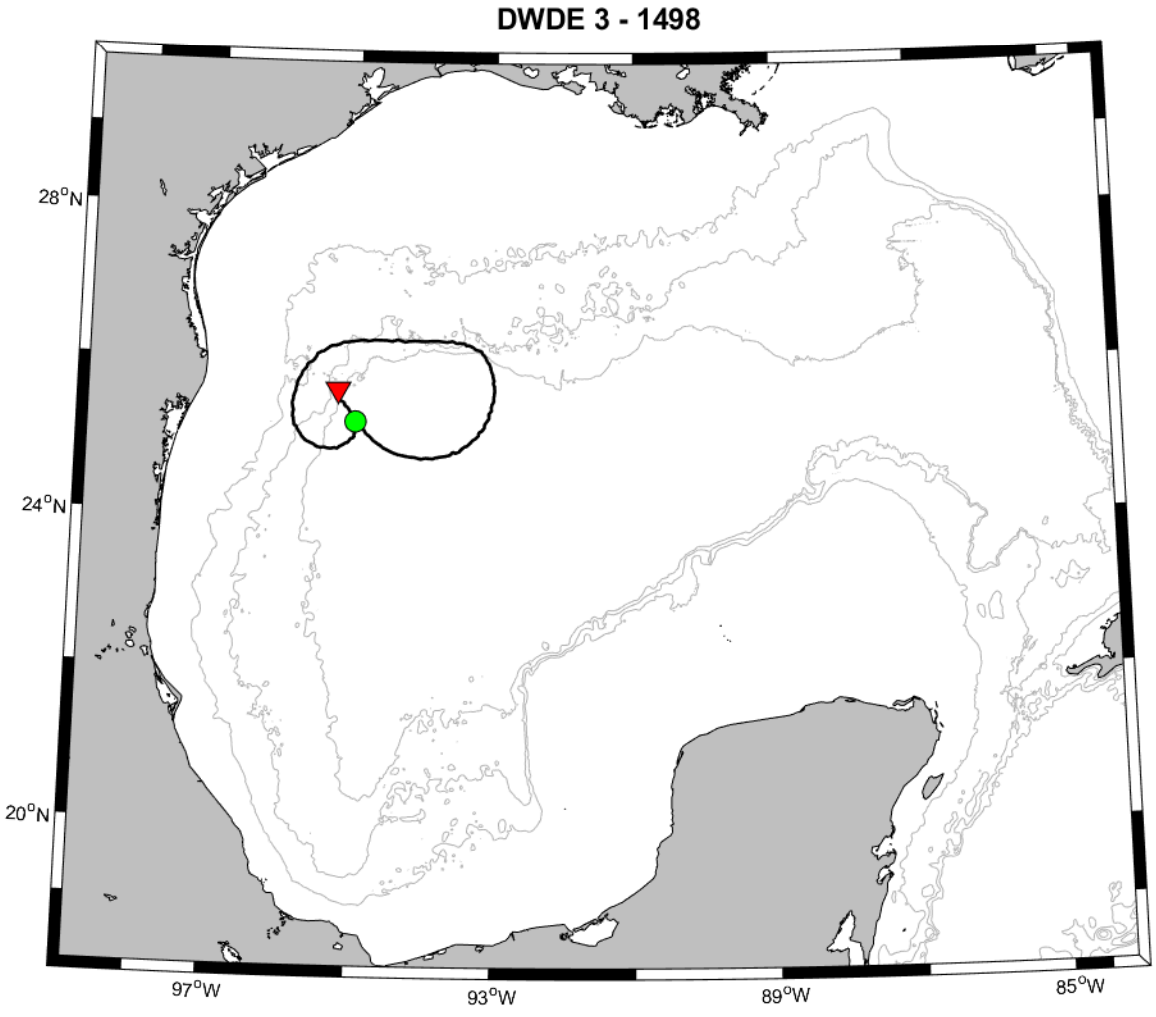

Float 1496 DWDE 3 (300-dbar)
temperature (℃)
13.8
11.8
9.8
pressure (db)
152
252
352
u-velocity (cm/s)
50
0
-50
v-velocity (cm/s)
50
0
-50
u-v velocity (cm/s)
50
0
-50
May 2017
Jul 2017
Sep 2017
Nov 2017
Jan 2018
Mar 2018
May 2018
Jul 2018
Sep 2018

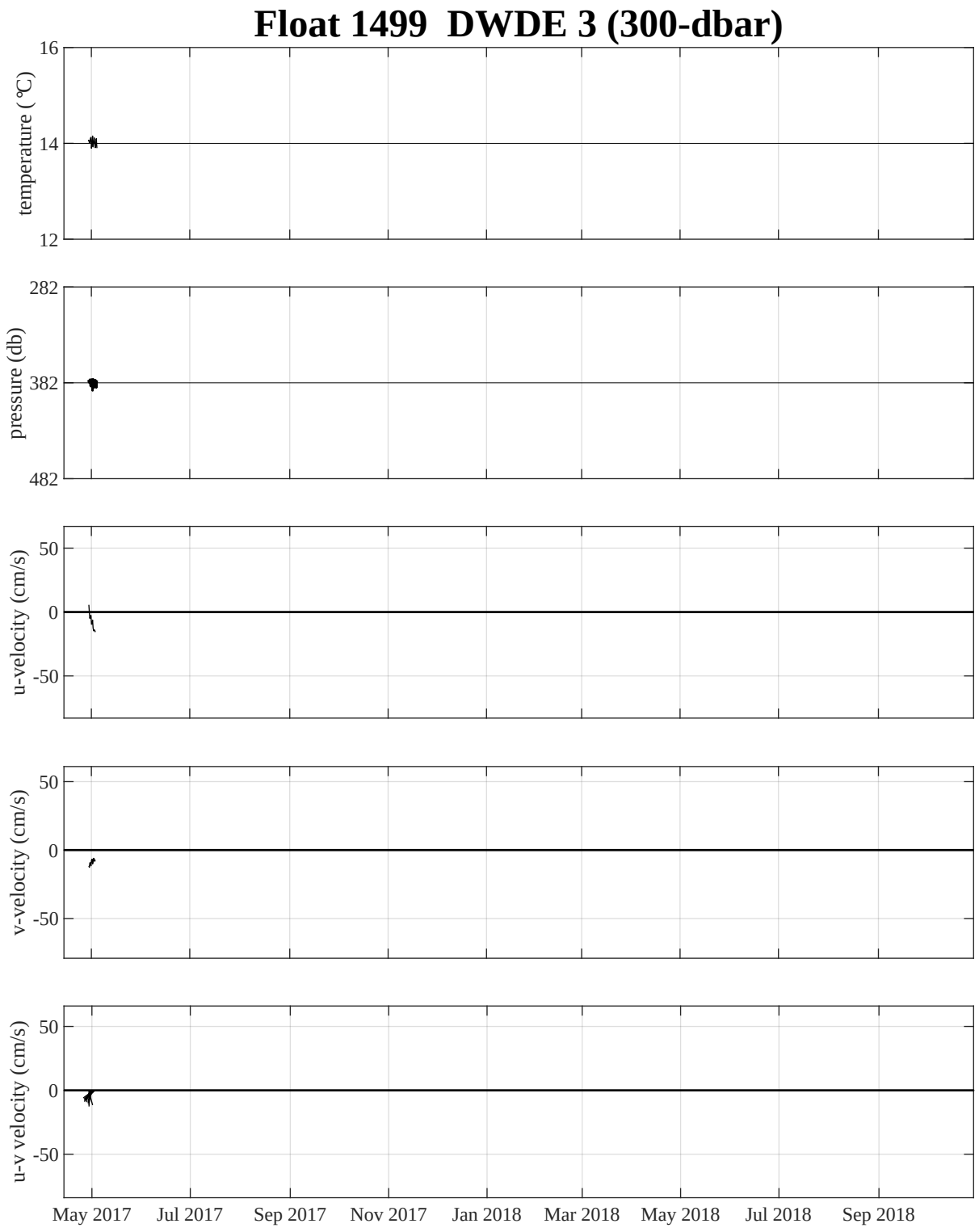

DWDE 3 - 1496
28°N
24°N
20°N
97°W
93°W
89°W
85°W

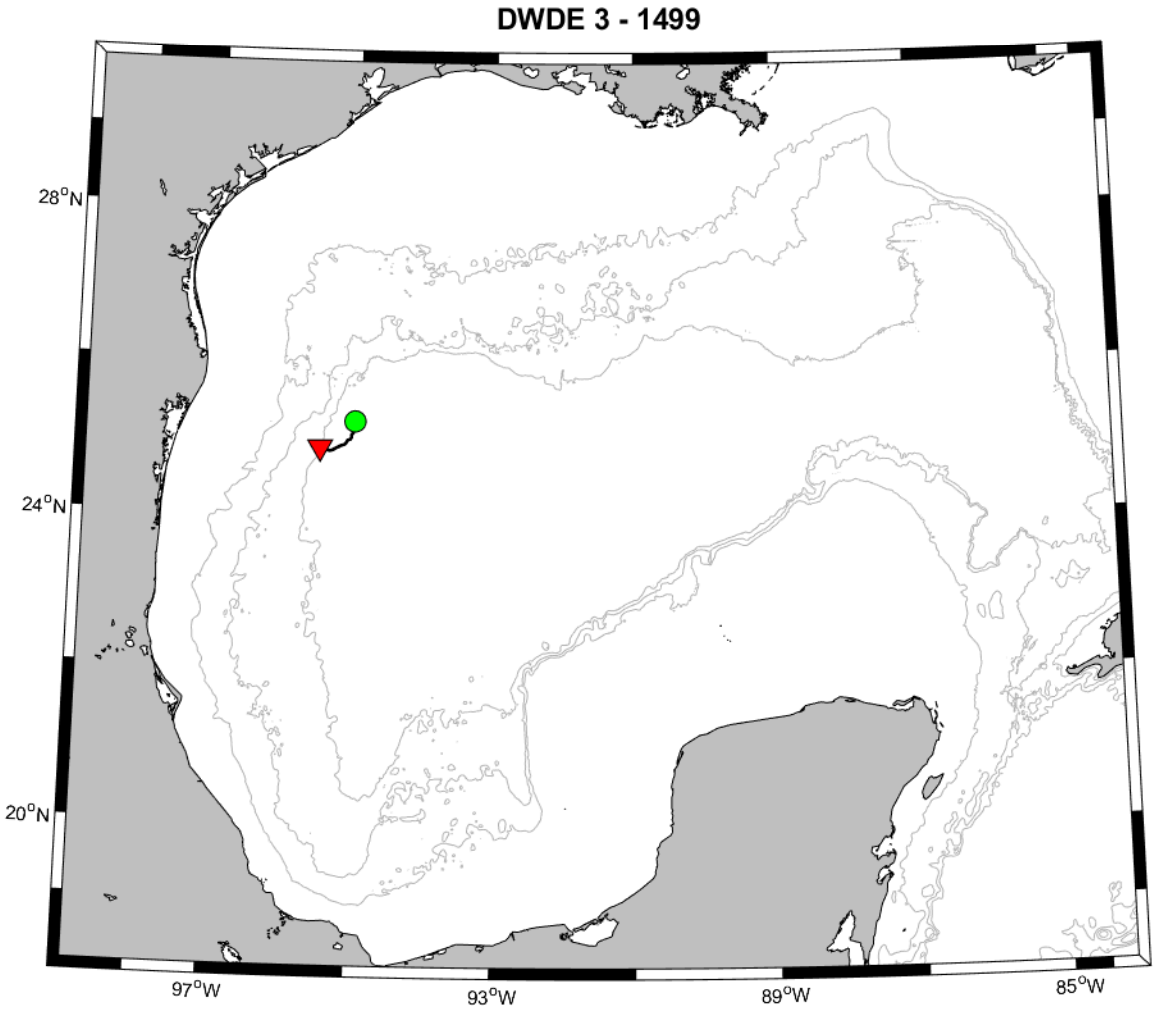

Float 1497 DWDE 3 (300-dbar)
temperature (℃)
14.6
12.6
10.6
pressure (db)
252
352
452
u-velocity (cm/s)
50
0
-50
v-velocity (cm/s)
50
0
-50
u-v velocity (cm/s)
50
0
-50
May 2017
Jul 2017
Sep 2017
Nov 2017
Jan 2018
Mar 2018
May 2018
Jul 2018
Sep 2018

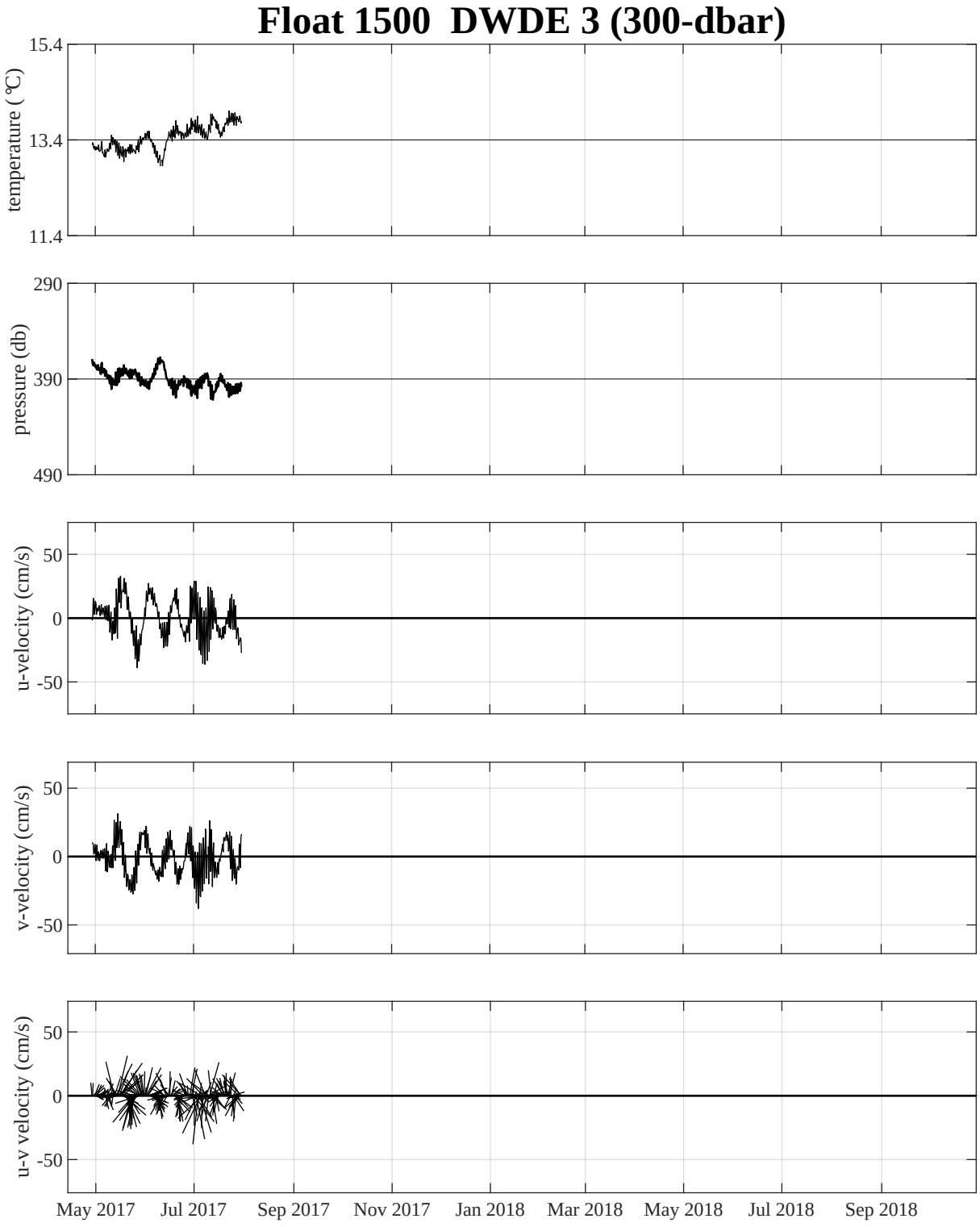

DWDE 3 - 1497
28°N
24°N
20°N
97°W
93°W
89°W
85°W

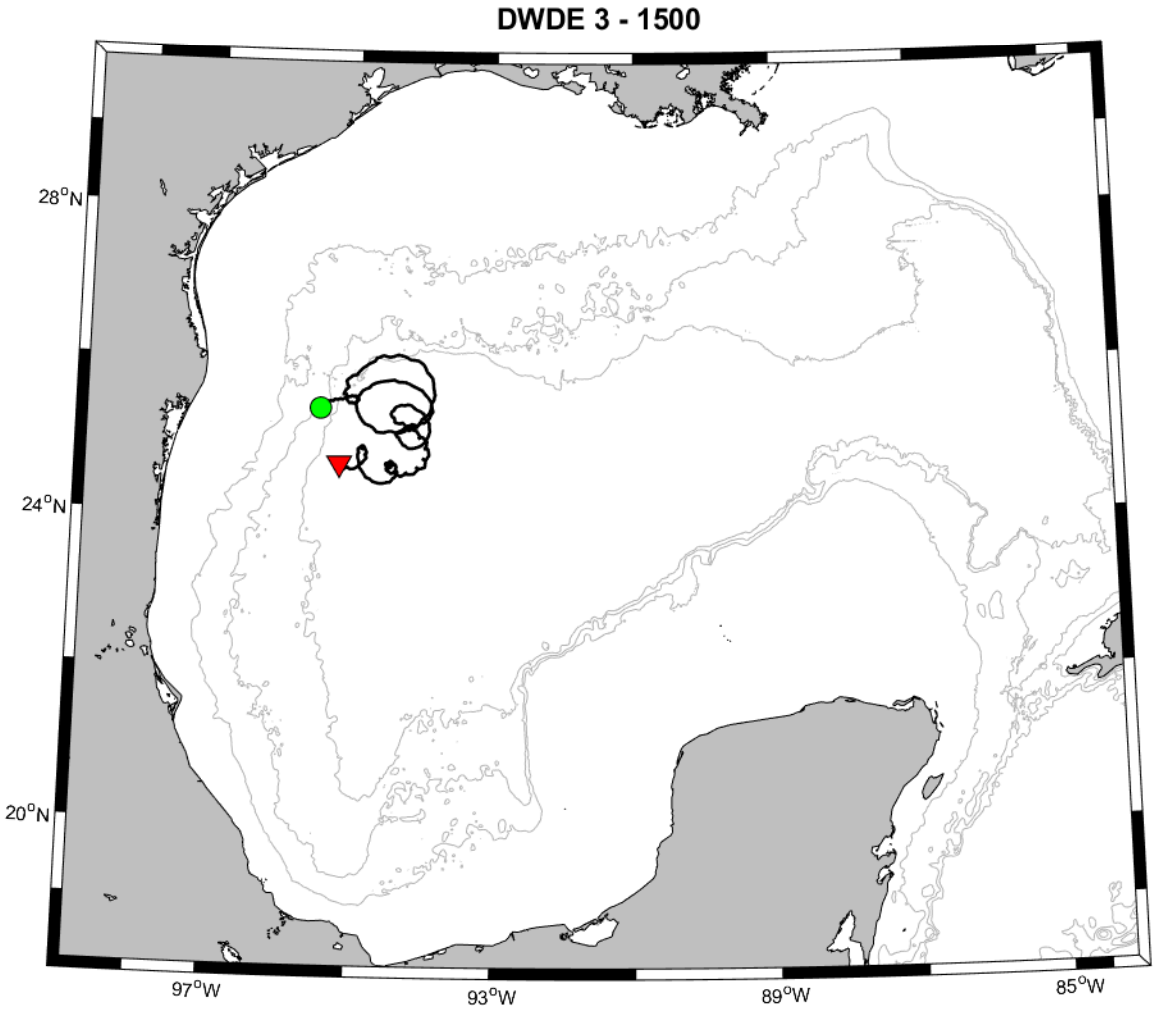

Float 1498 DWDE 3 (300-dbar)
temperature (℃)
15.1
13.1
11.1
pressure (db)
255
355
455
u-velocity (cm/s)
50
0
-50
v-velocity (cm/s)
50
0
-50
u-v velocity (cm/s)
50
0
-50
May 2017
Jul 2017
Sep 2017
Nov 2017
Jan 2018
Mar 2018
May 2018
Jul 2018
Sep 2018

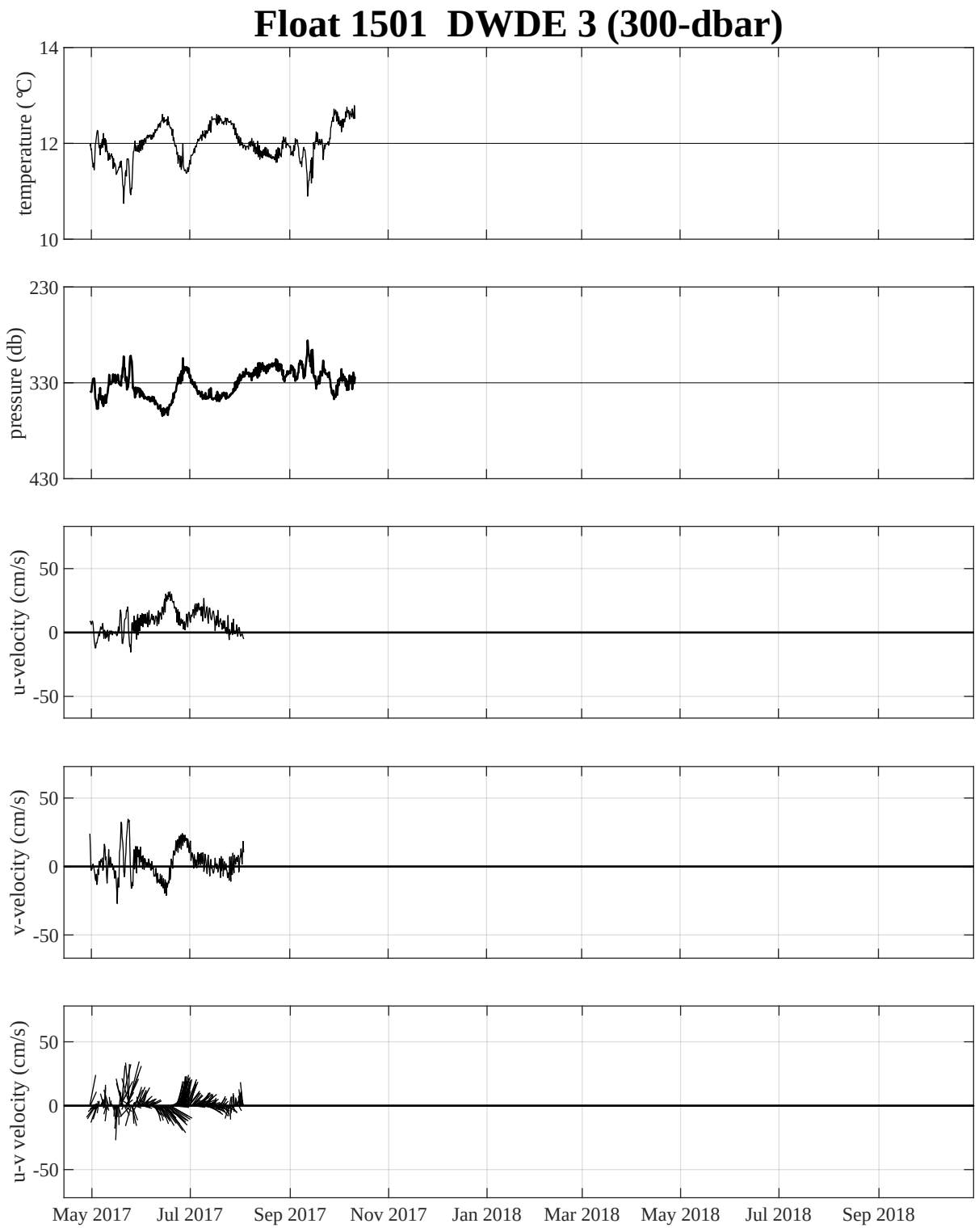

DWDE 3 - 1498
28°N
24°N
20°N
97°W
93°W
89°W
85°W

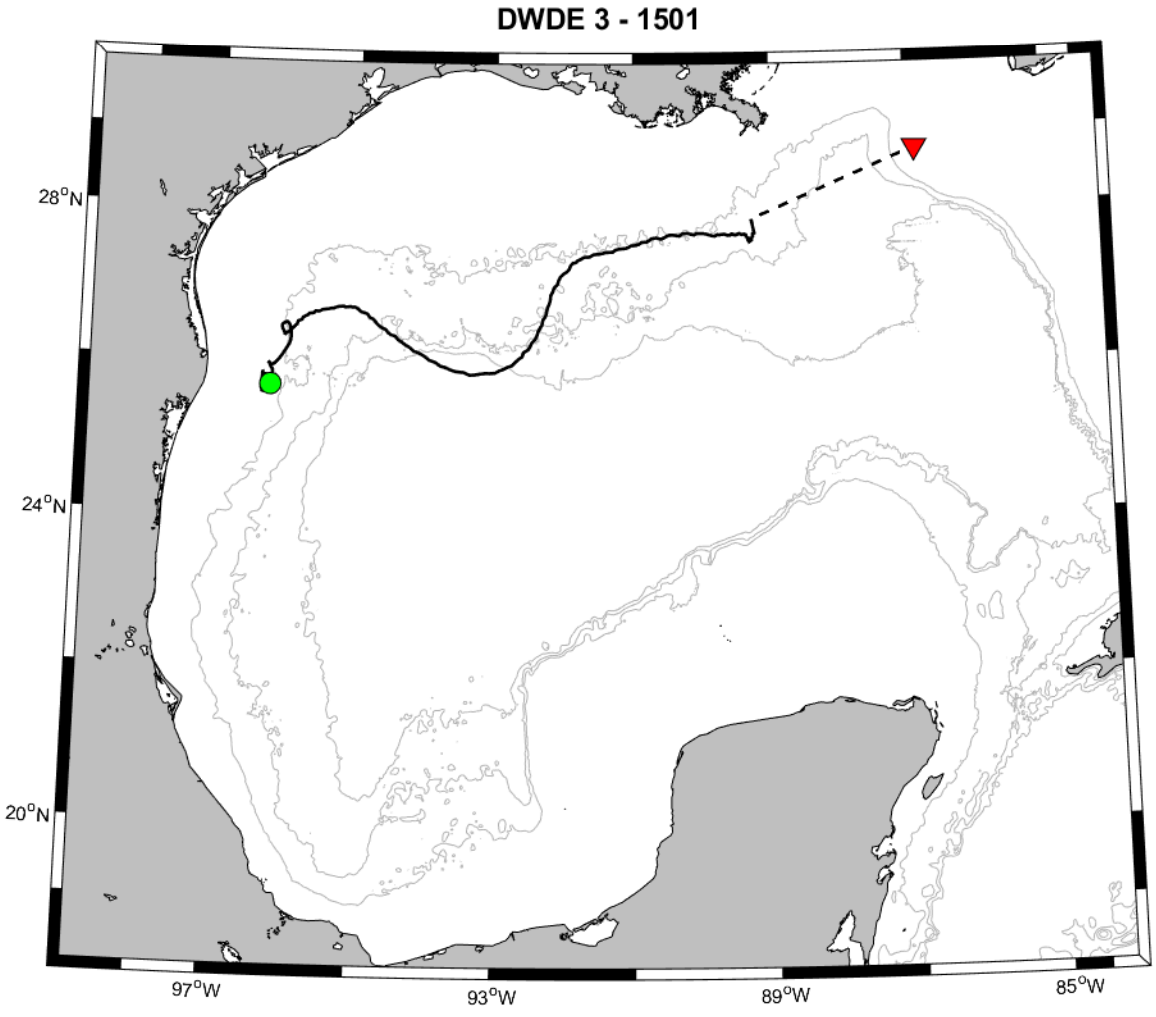

Float 1499 DWDE 3 (300-dbar)
temperature (°C)
16
14
12
pressure (db)
282
382
482
u-velocity (cm/s)
50
0
-50
v-velocity (cm/s)
50
0
-50
u-v velocity (cm/s)
50
0
-50
May 2017
Jul 2017
Sep 2017
Nov 2017
Jan 2018
Mar 2018
May 2018
Jul 2018
Sep 2018

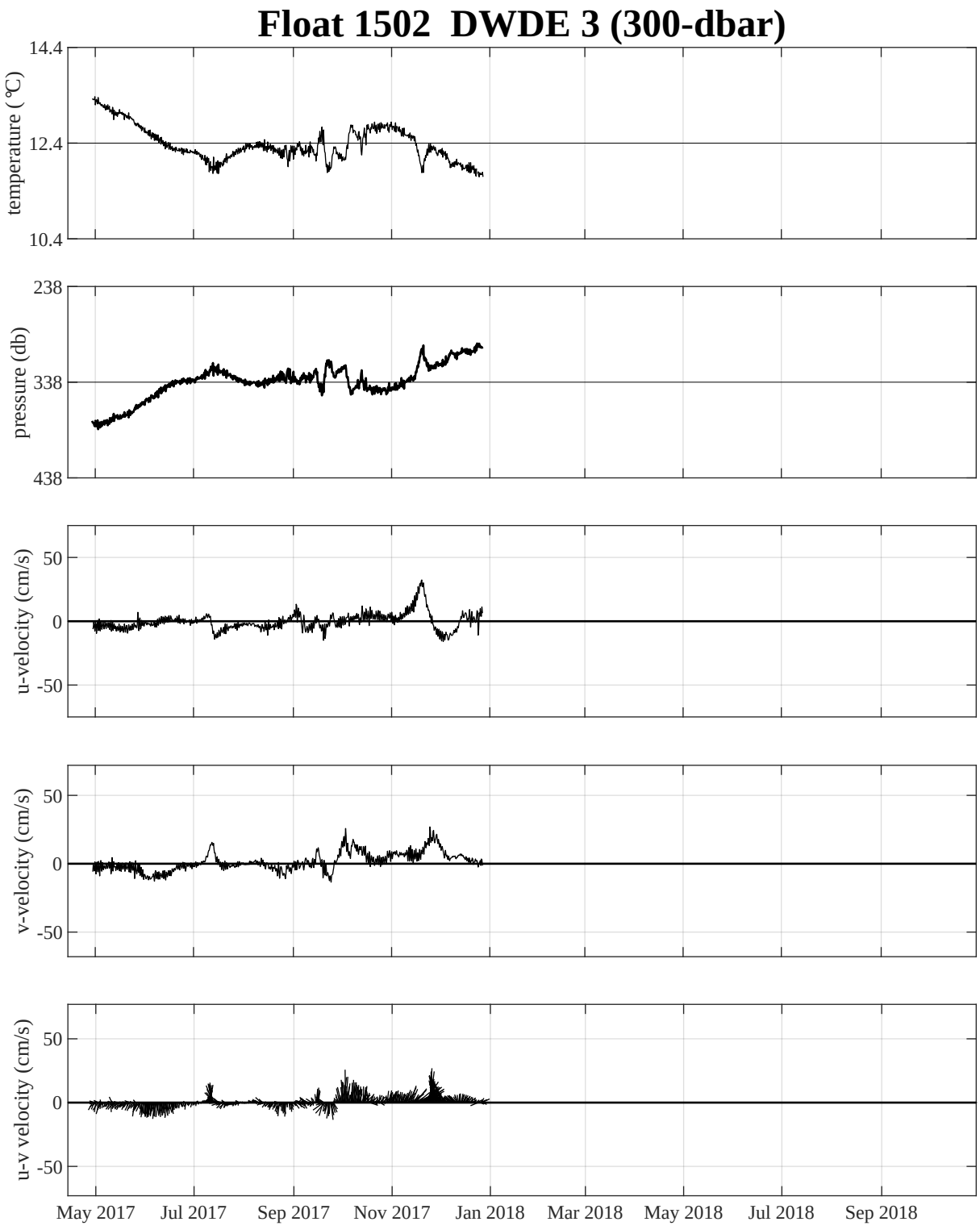

DWDE 3 - 1499
28°N
24°N
20°N
97°W
93°W
89°W
85°W

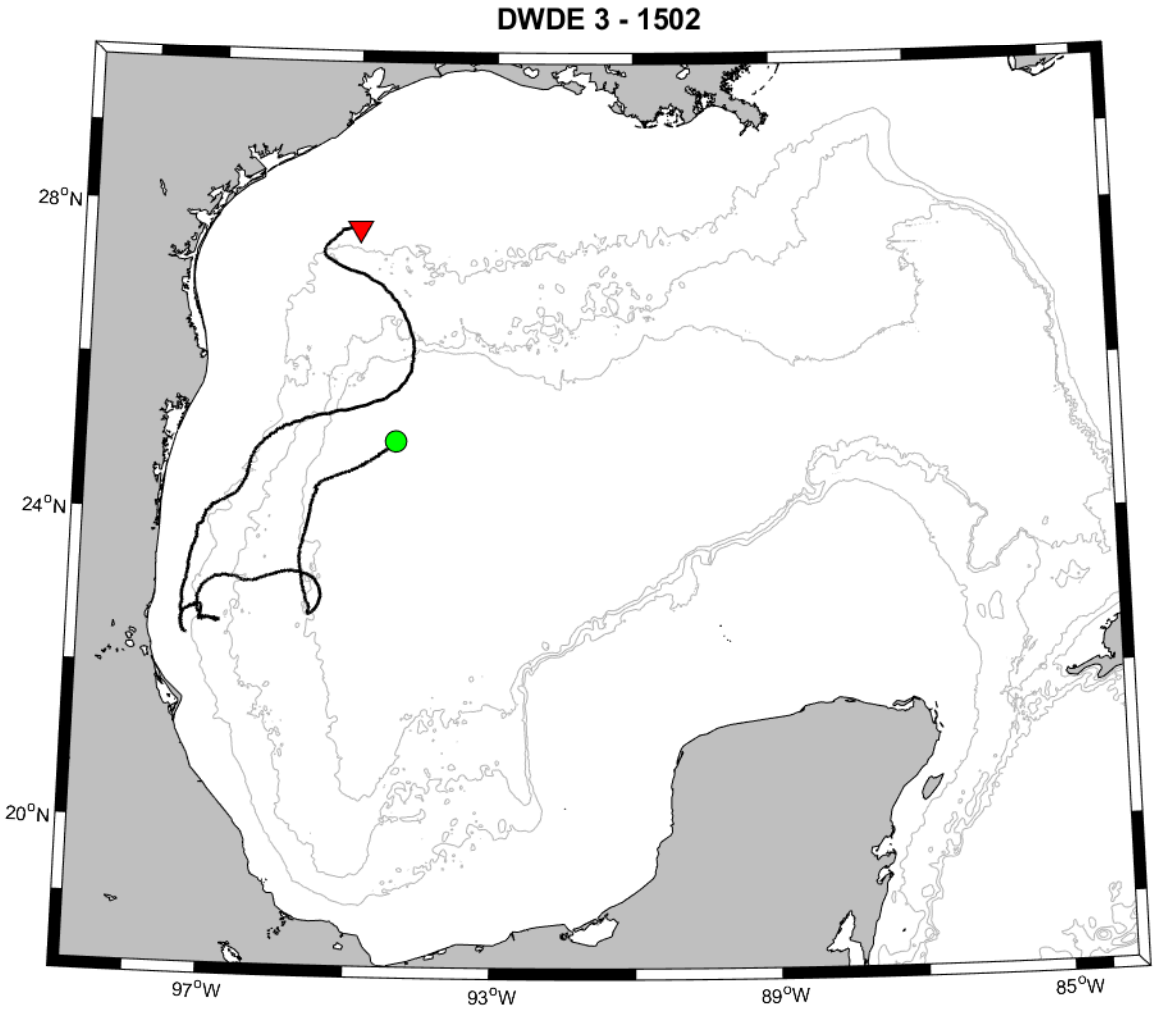

Float 1500 DWDE 3 (300-dbar)
temperature (℃)
15.4
13.4
11.4
pressure (db)
290
390
490
u-velocity (cm/s)
50
0
-50
v-velocity (cm/s)
50
0
-50
u-v velocity (cm/s)
50
0
-50
May 2017
Jul 2017
Sep 2017
Nov 2017
Jan 2018
Mar 2018
May 2018
Jul 2018
Sep 2018

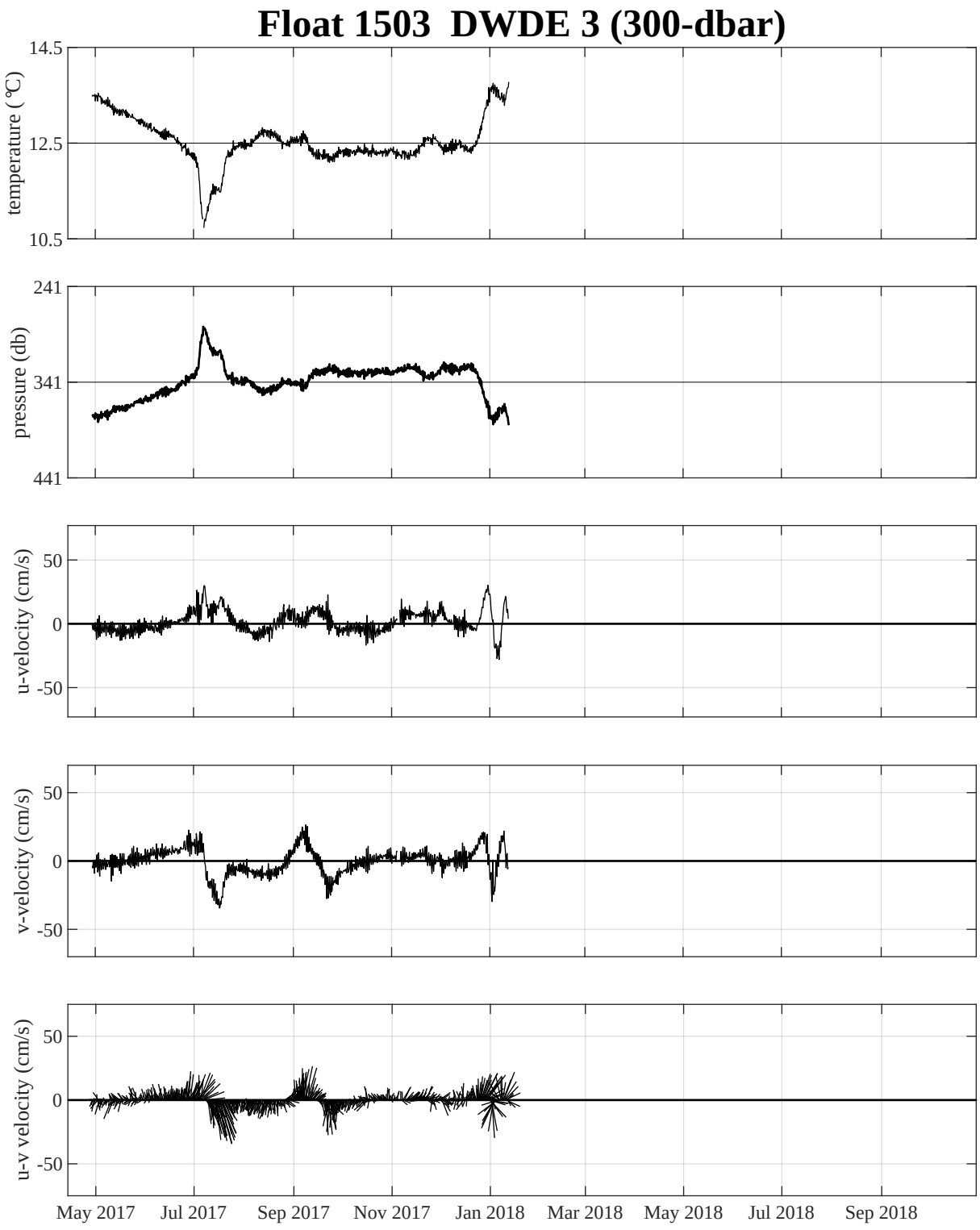

DWDE 3 - 1500
28°N
24°N
20°N
97°W
93°W
89°W
85°W

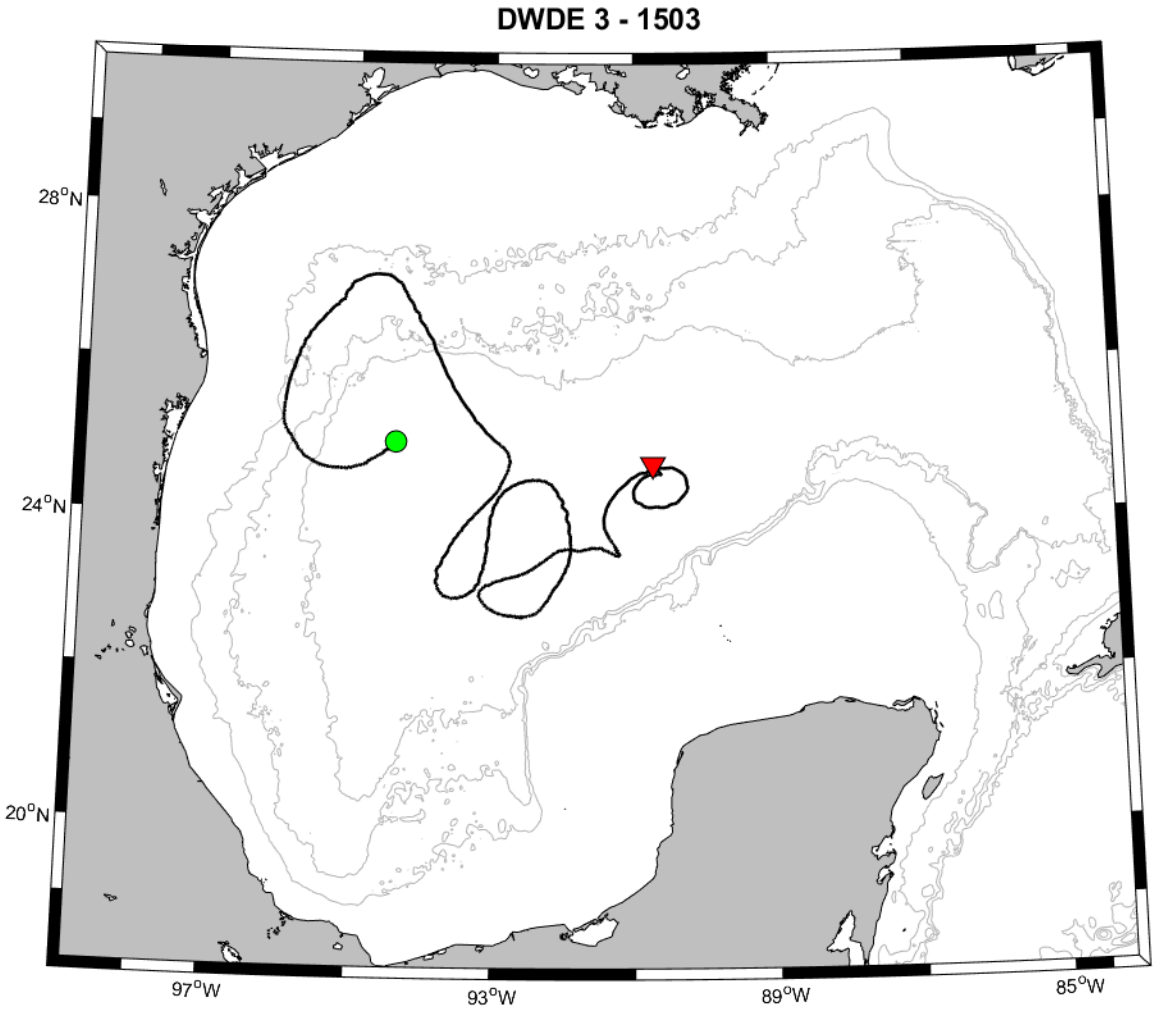

Float 1501 DWDE 3 (300-dbar)
temperature (°C)
14
12
10
pressure (db)
230
330
430
u-velocity (cm/s)
50
0
-50
v-velocity (cm/s)
50
0
-50
u-v velocity (cm/s)
50
0
-50
May 2017
Jul 2017
Sep 2017
Nov 2017
Jan 2018
Mar 2018
May 2018
Jul 2018
Sep 2018

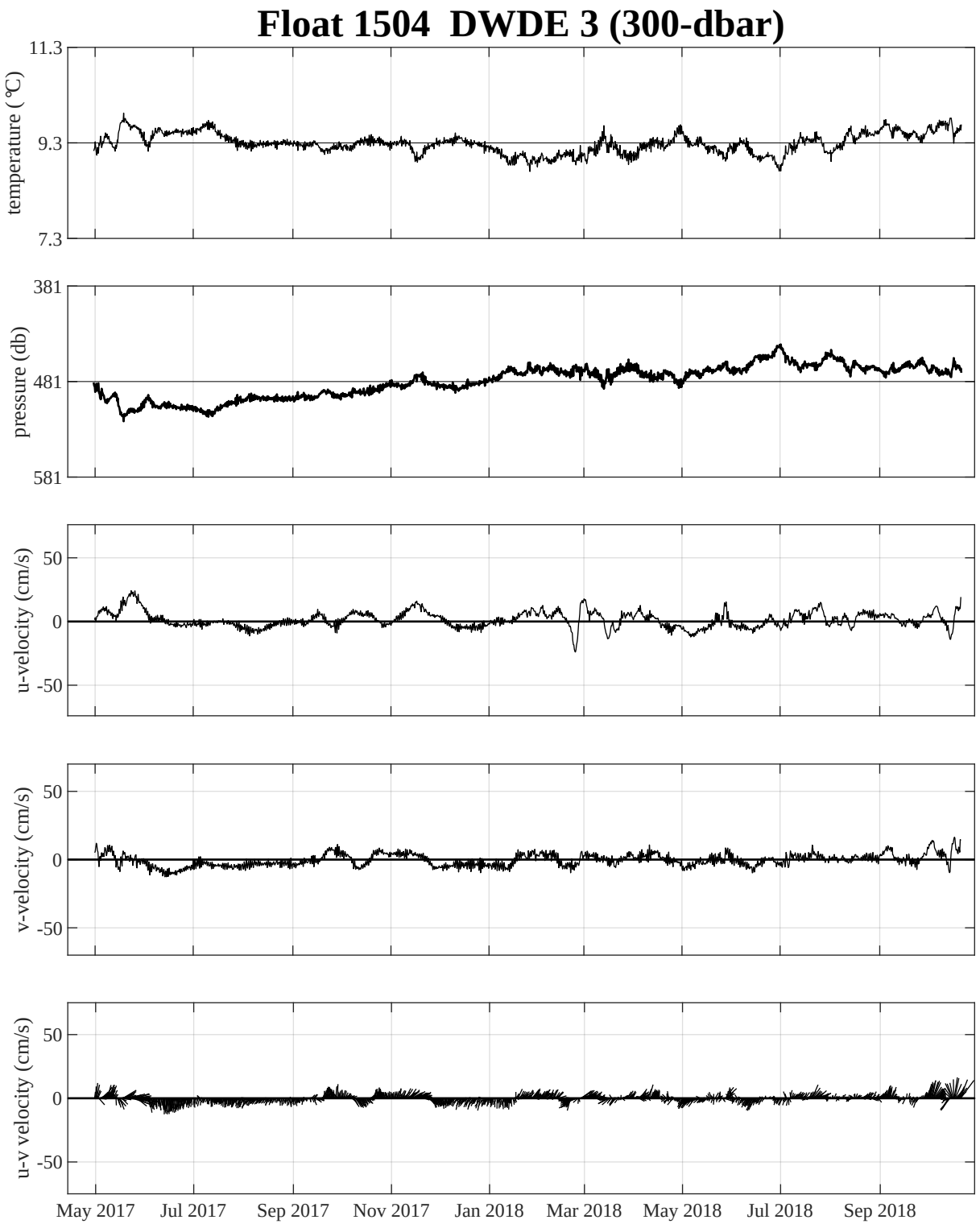

DWDE 3 - 1501
28°N
24°N
20°N
97°W
93°W
89°W
85°W

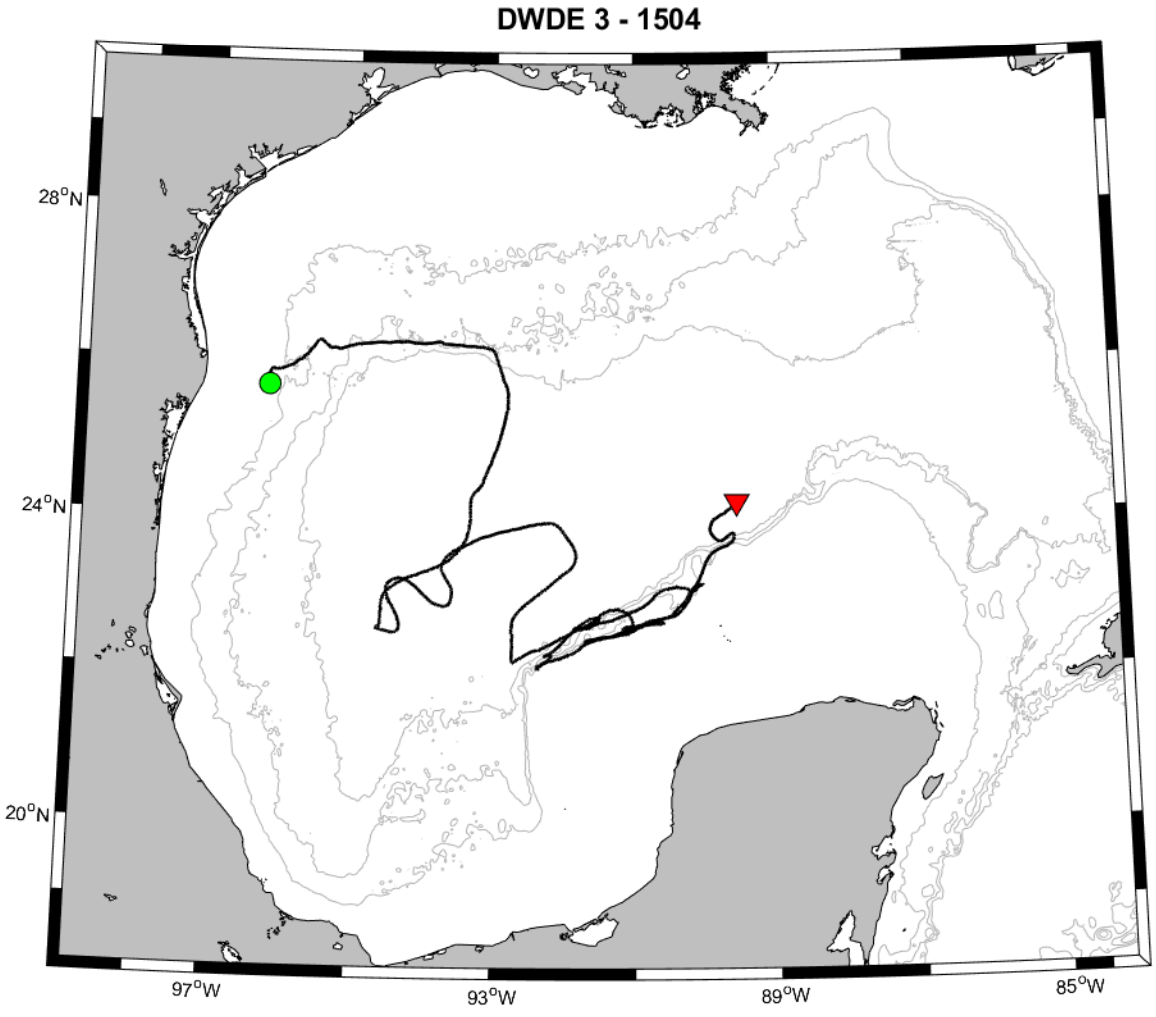

Float 1502 DWDE 3 (300-dbar)
temperature (℃)
14.4
12.4
10.4
pressure (db)
238
338
438
u-velocity (cm/s)
50
0
-50
v-velocity (cm/s)
50
0
-50
u-v velocity (cm/s)
50
0
-50
May 2017
Jul 2017
Sep 2017
Nov 2017
Jan 2018
Mar 2018
May 2018
Jul 2018
Sep 2018

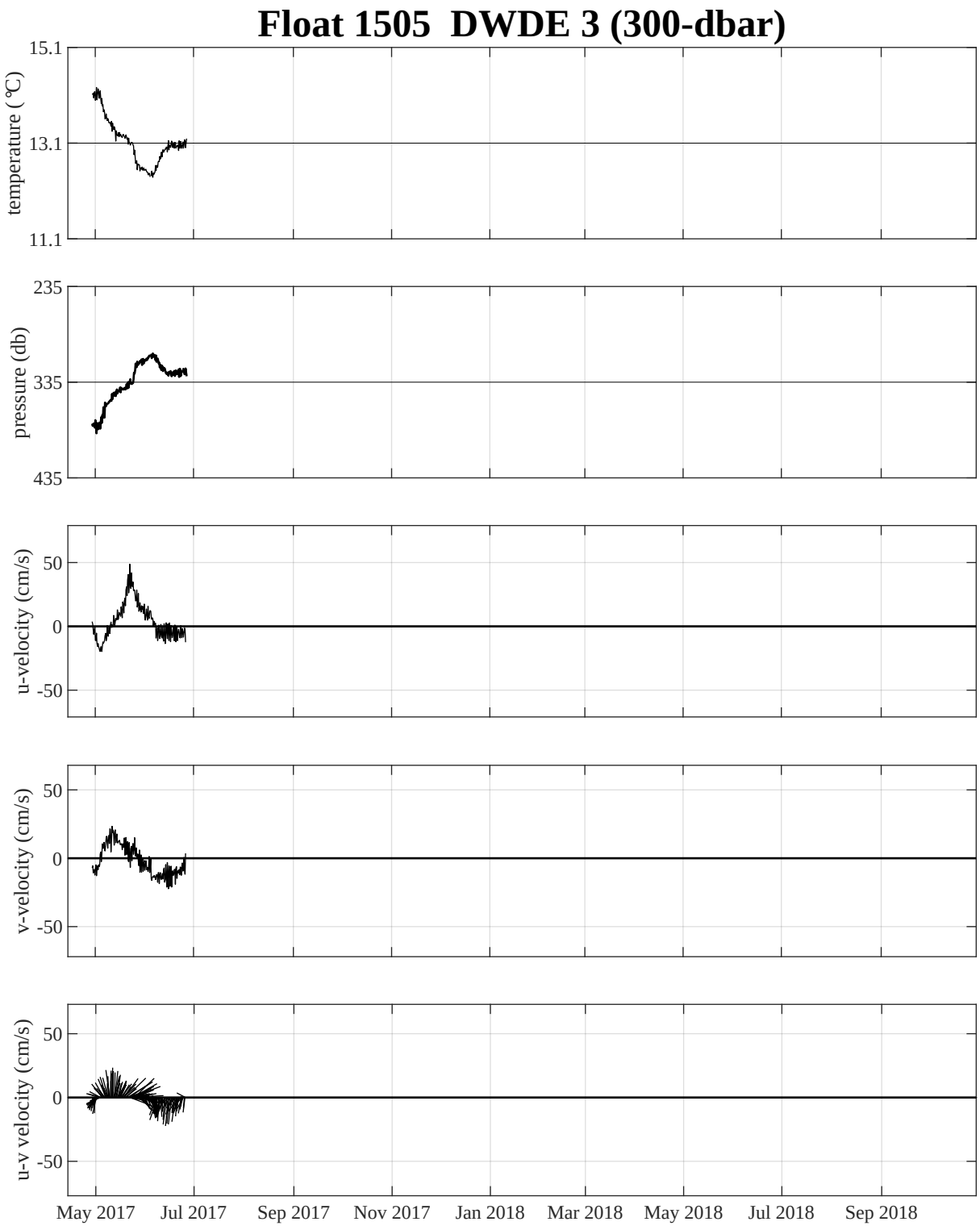

DWDE 3 - 1502
28°N
24°N
20°N
97°W
93°W
89°W
85°W

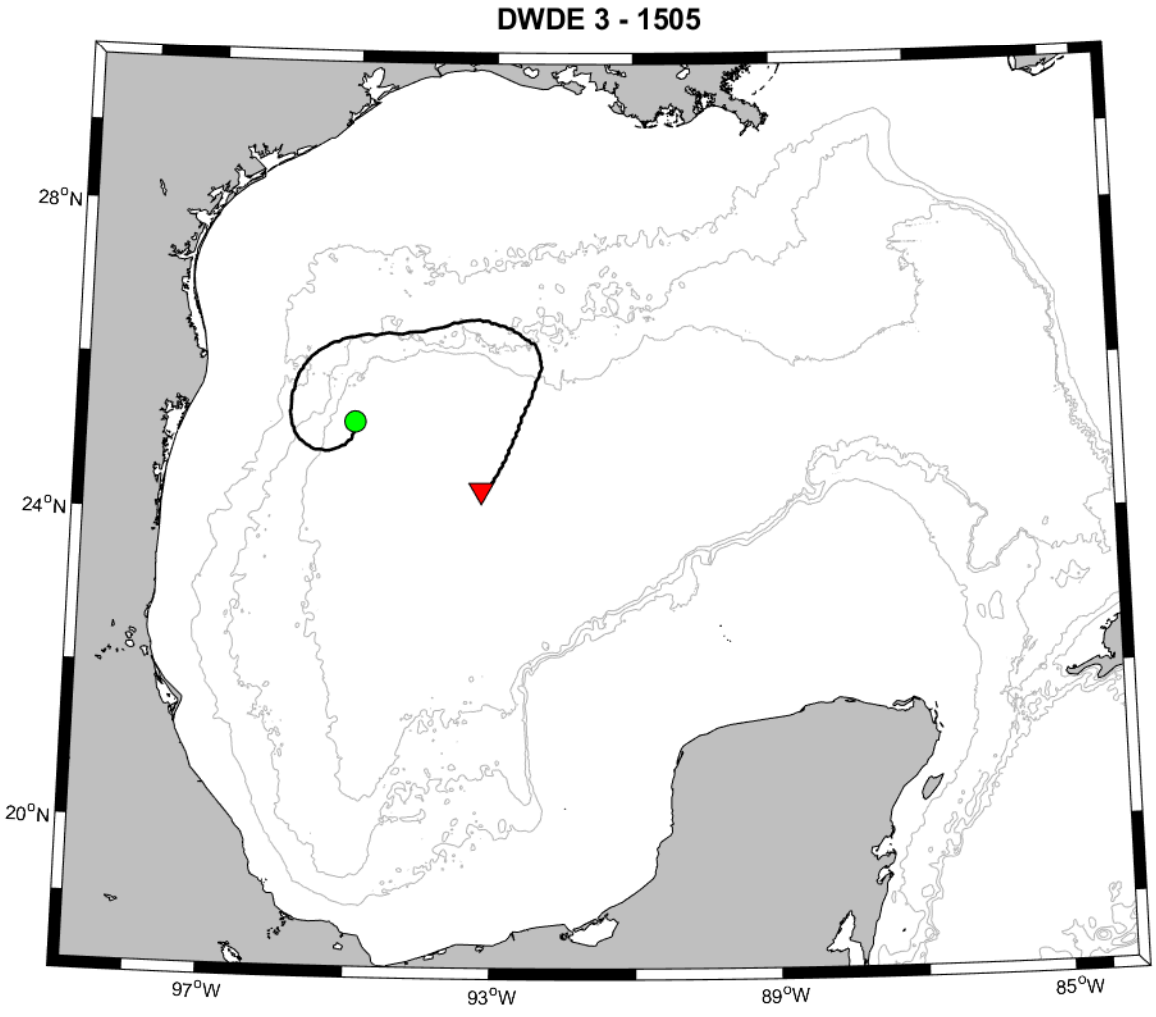

Float 1503 DWDE 3 (300-dbar)
temperature (℃)
14.5
12.5
10.5
pressure (db)
241
341
441
u-velocity (cm/s)
50
0
-50
v-velocity (cm/s)
50
0
-50
u-v velocity (cm/s)
50
0
-50
May 2017
Jul 2017
Sep 2017
Nov 2017
Jan 2018
Mar 2018
May 2018
Jul 2018
Sep 2018

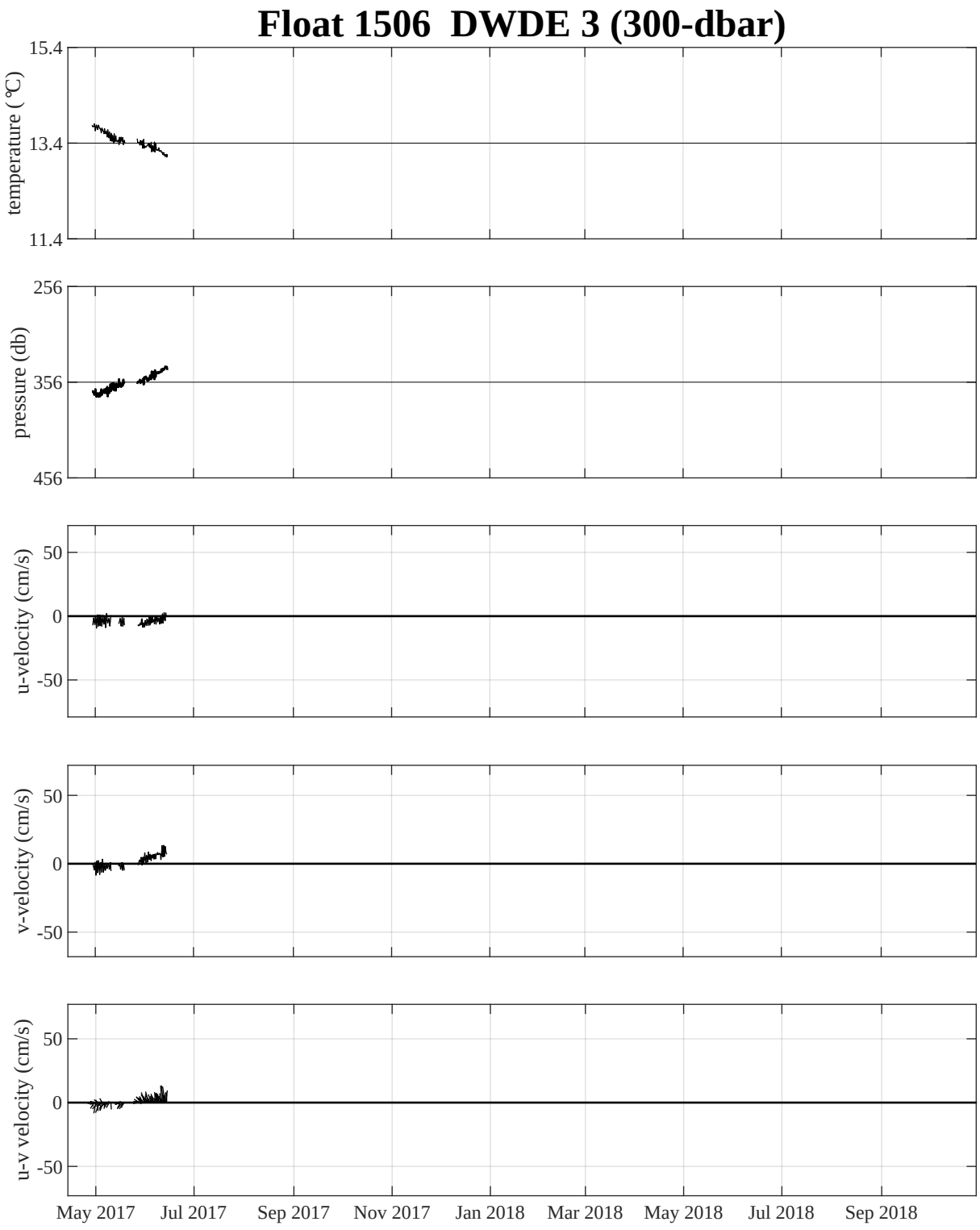

DWDE 3 - 1503
28°N
24°N
20°N
97°W
93°W
89°W
85°W

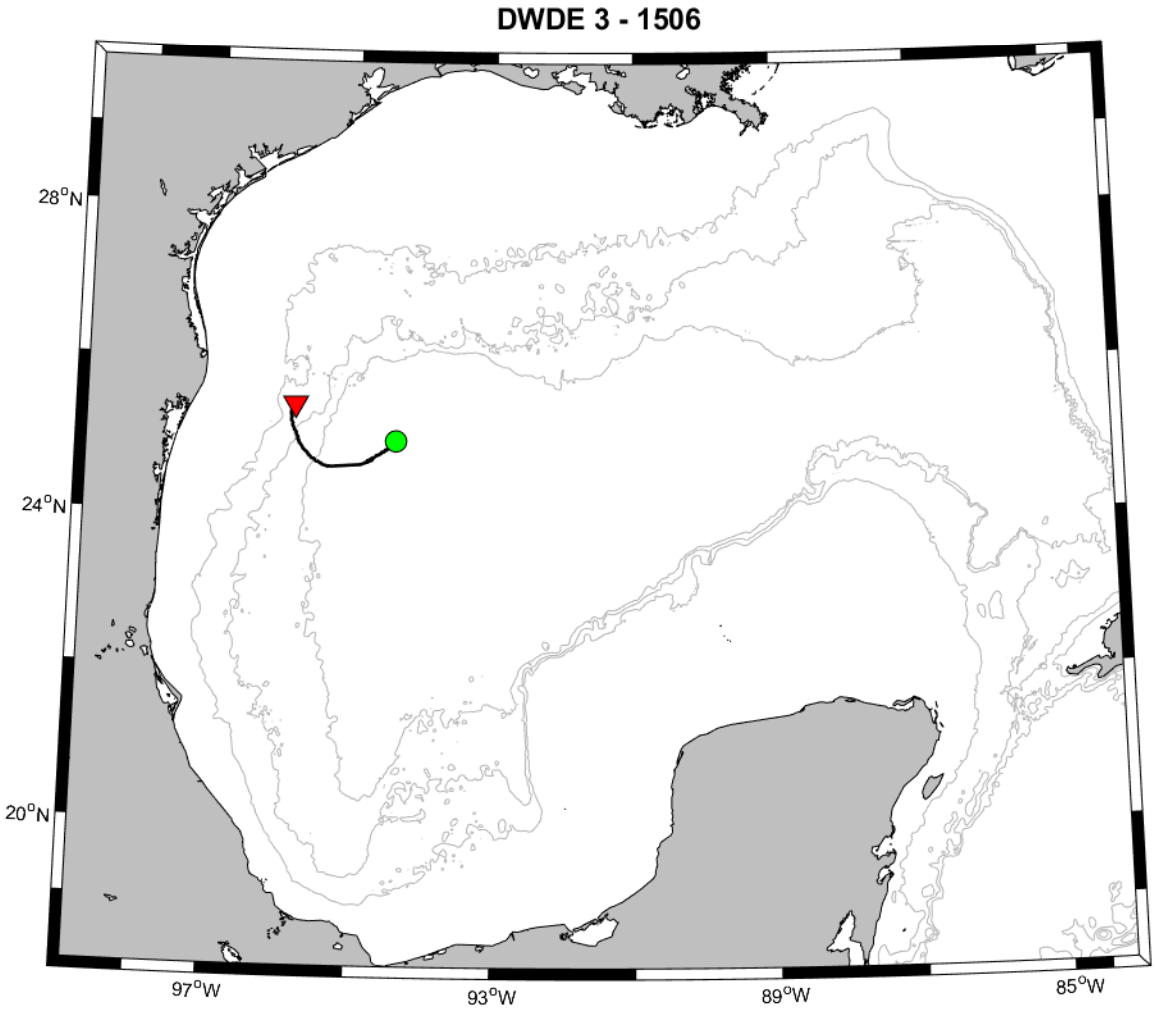

Float 1504 DWDE 3 (300-dbar)
temperature (℃)
11.3
9.3
7.3
pressure (db)
381
481
581
u-velocity (cm/s)
50
0
-50
v-velocity (cm/s)
50
0
-50
u-v velocity (cm/s)
50
0
-50
May 2017
Jul 2017
Sep 2017
Nov 2017
Jan 2018
Mar 2018
May 2018
Jul 2018
Sep 2018

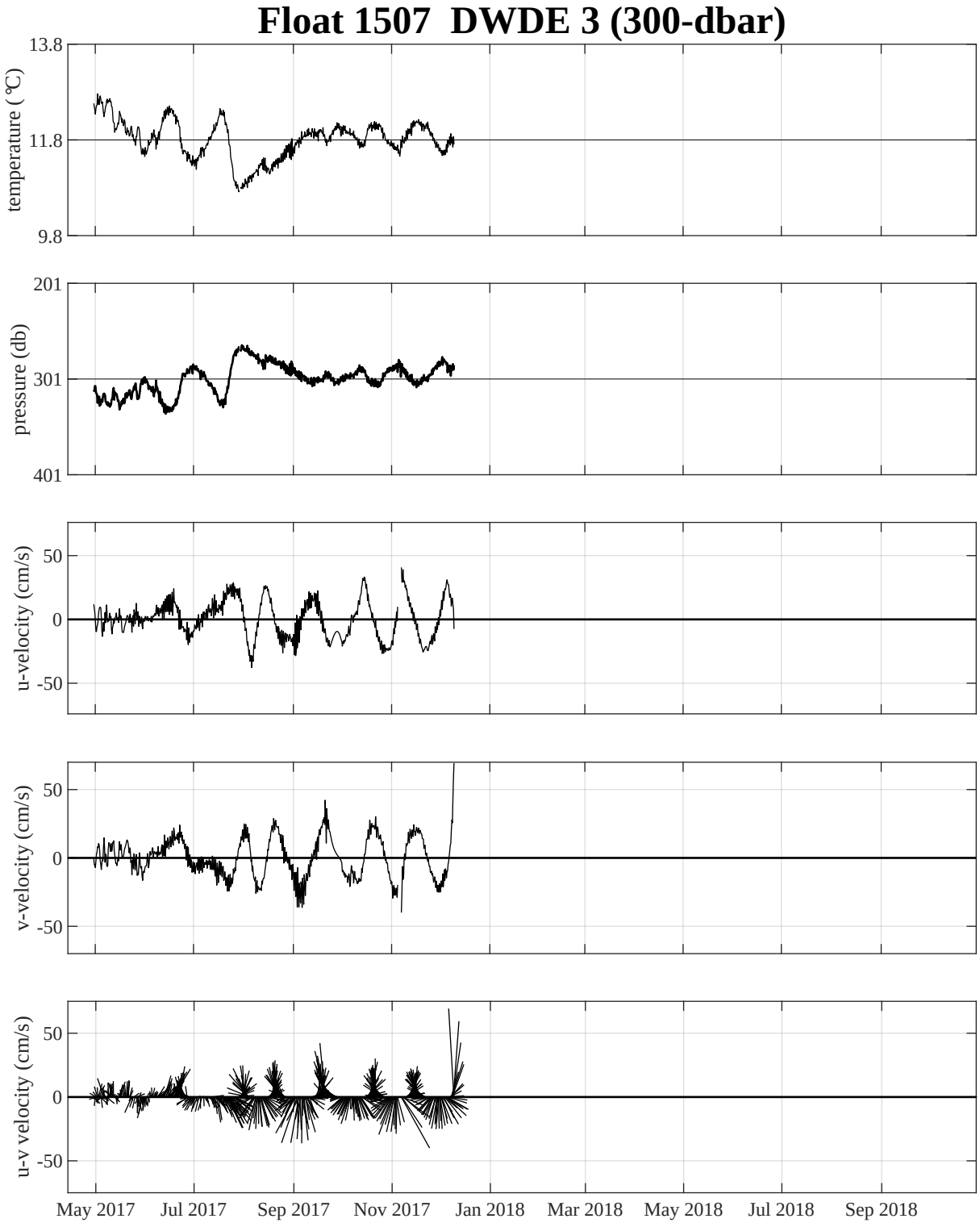

DWDE 3 - 1504
28°N
24°N
20°N
97°W
93°W
89°W
85°W

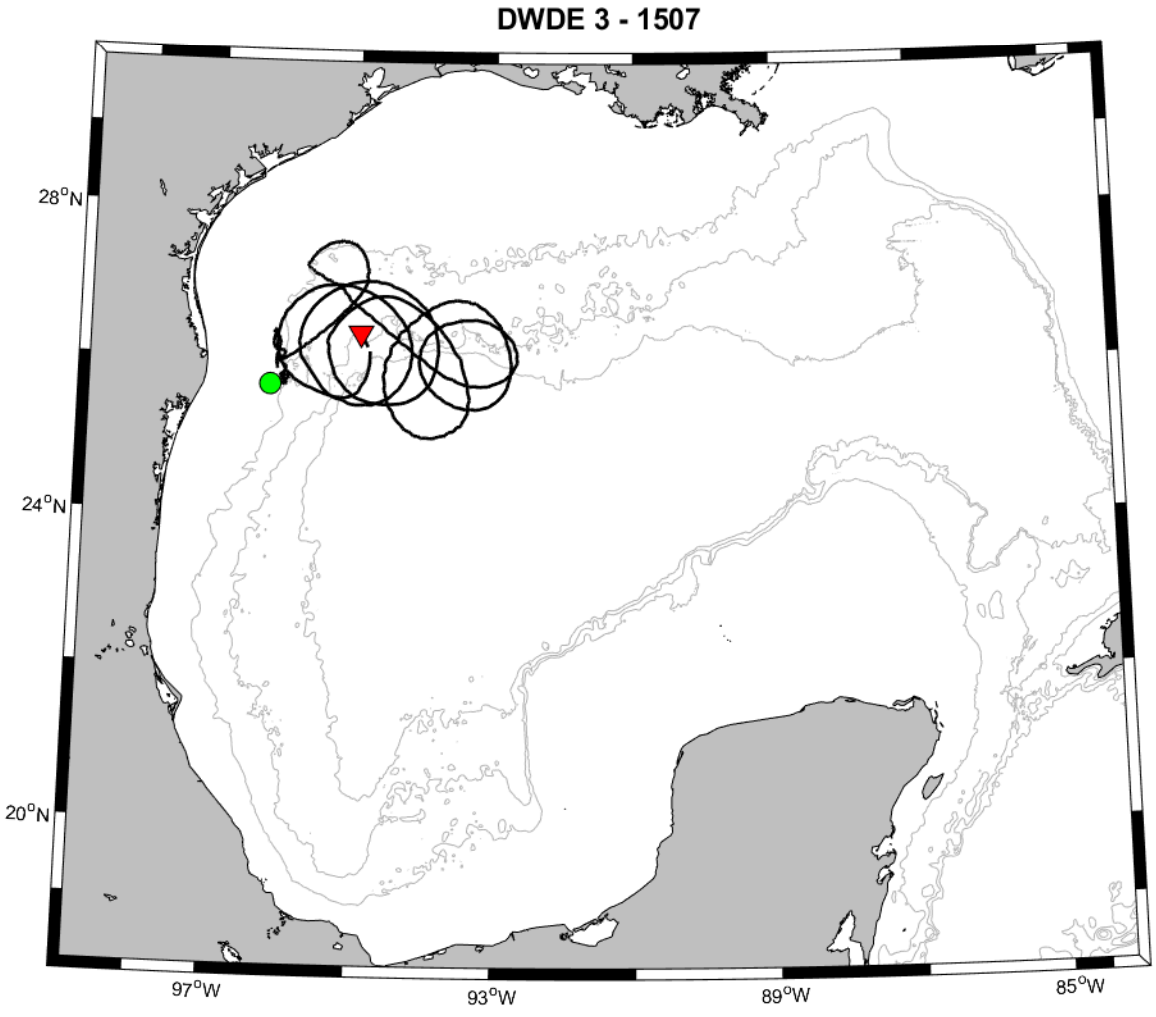

Float 1505 DWDE 3 (300-dbar)
temperature (℃)
15.1
13.1
11.1
pressure (db)
235
335
435
u-velocity (cm/s)
50
0
-50
v-velocity (cm/s)
50
0
-50
u-v velocity (cm/s)
50
0
-50
May 2017
Jul 2017
Sep 2017
Nov 2017
Jan 2018
Mar 2018
May 2018
Jul 2018
Sep 2018

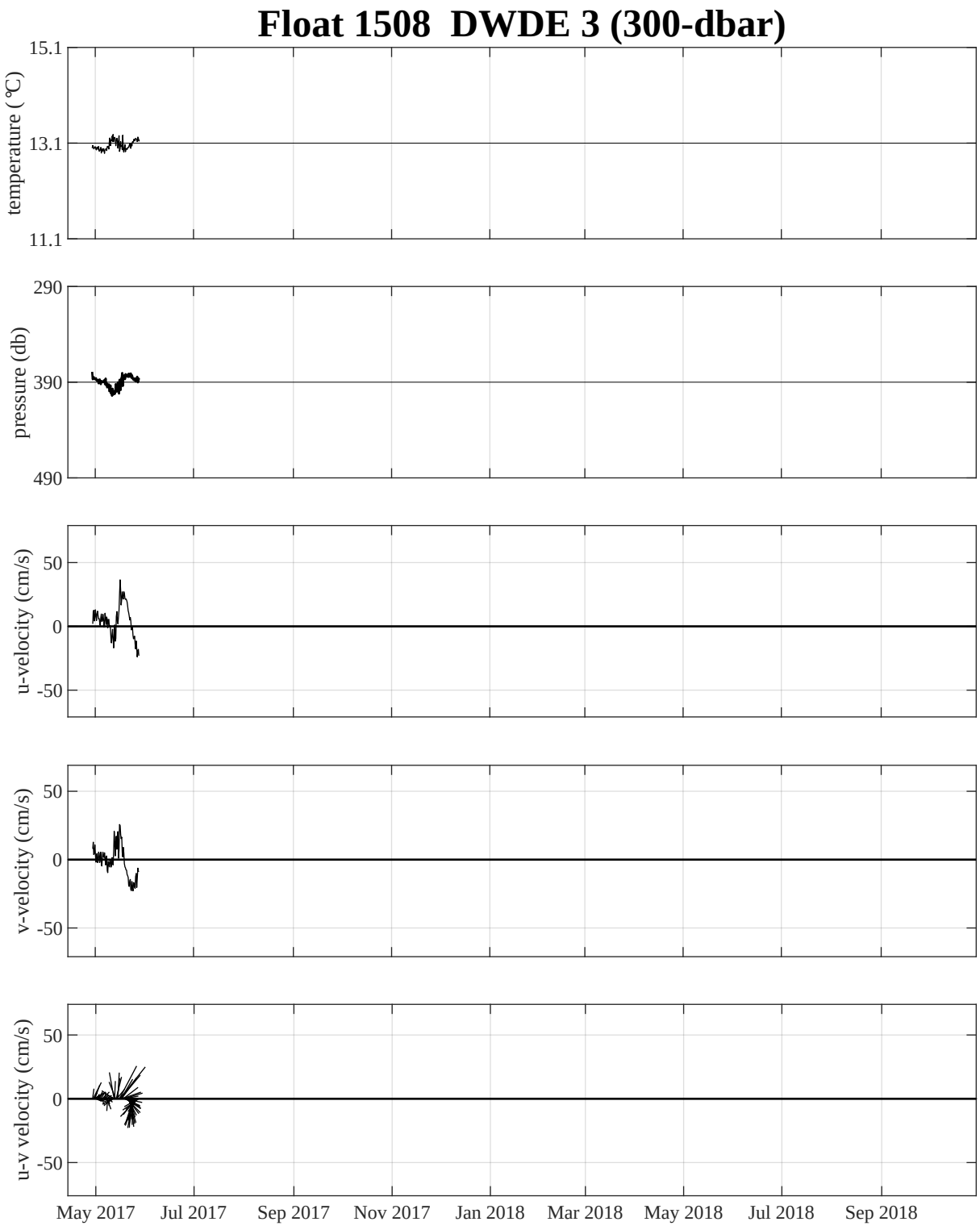

DWDE 3 - 1505
28°N
24°N
20°N
97°W
93°W
89°W
85°W

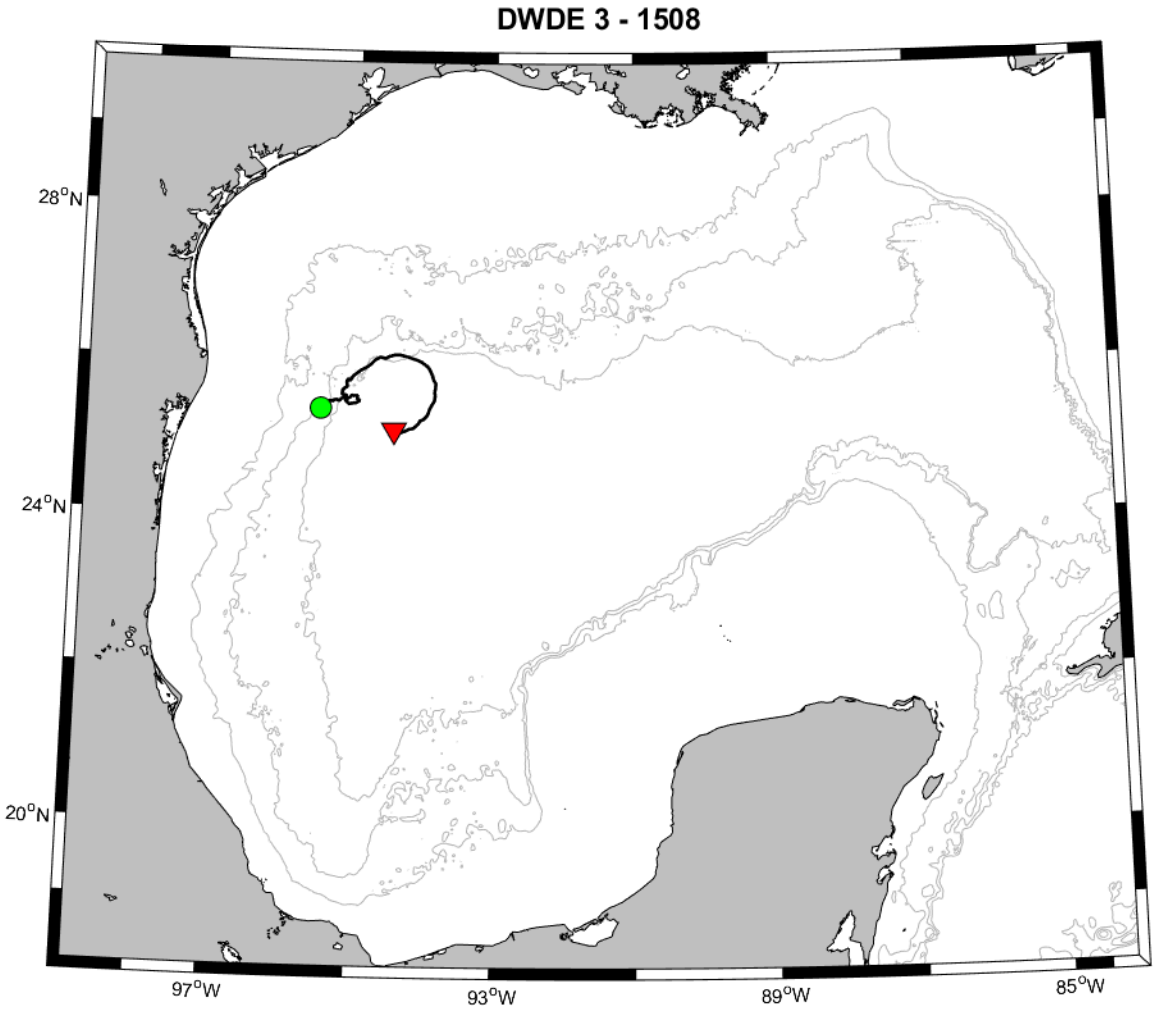

Float 1506 DWDE 3 (300-dbar)
temperature (℃)
15.4
13.4
11.4
pressure (db)
256
356
456
u-velocity (cm/s)
50
0
-50
v-velocity (cm/s)
50
0
-50
u-v velocity (cm/s)
50
0
-50
May 2017
Jul 2017
Sep 2017
Nov 2017
Jan 2018
Mar 2018
May 2018
Jul 2018
Sep 2018

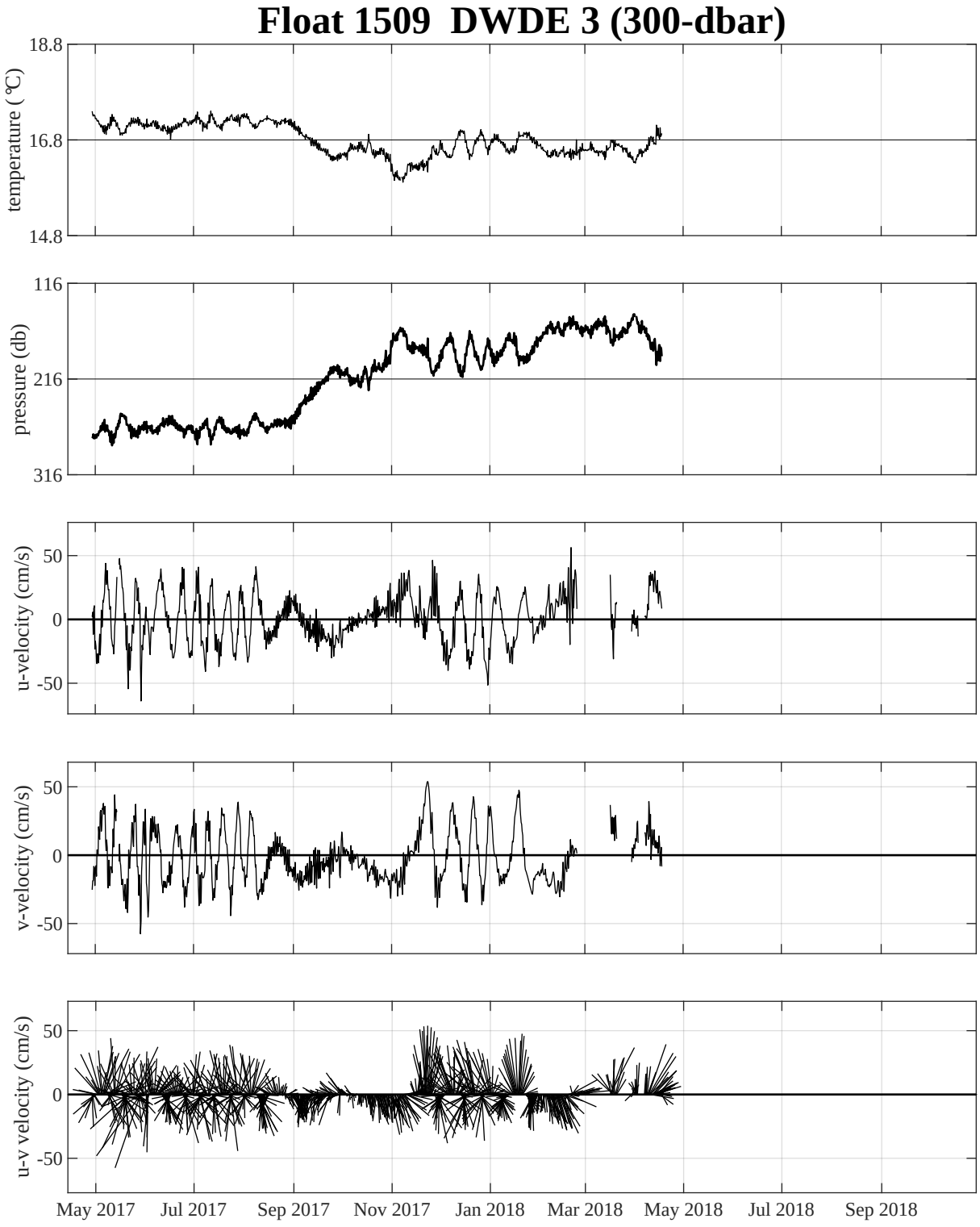

DWDE 3 - 1506
28°N
24°N
20°N
97°W
93°W
89°W
85°W

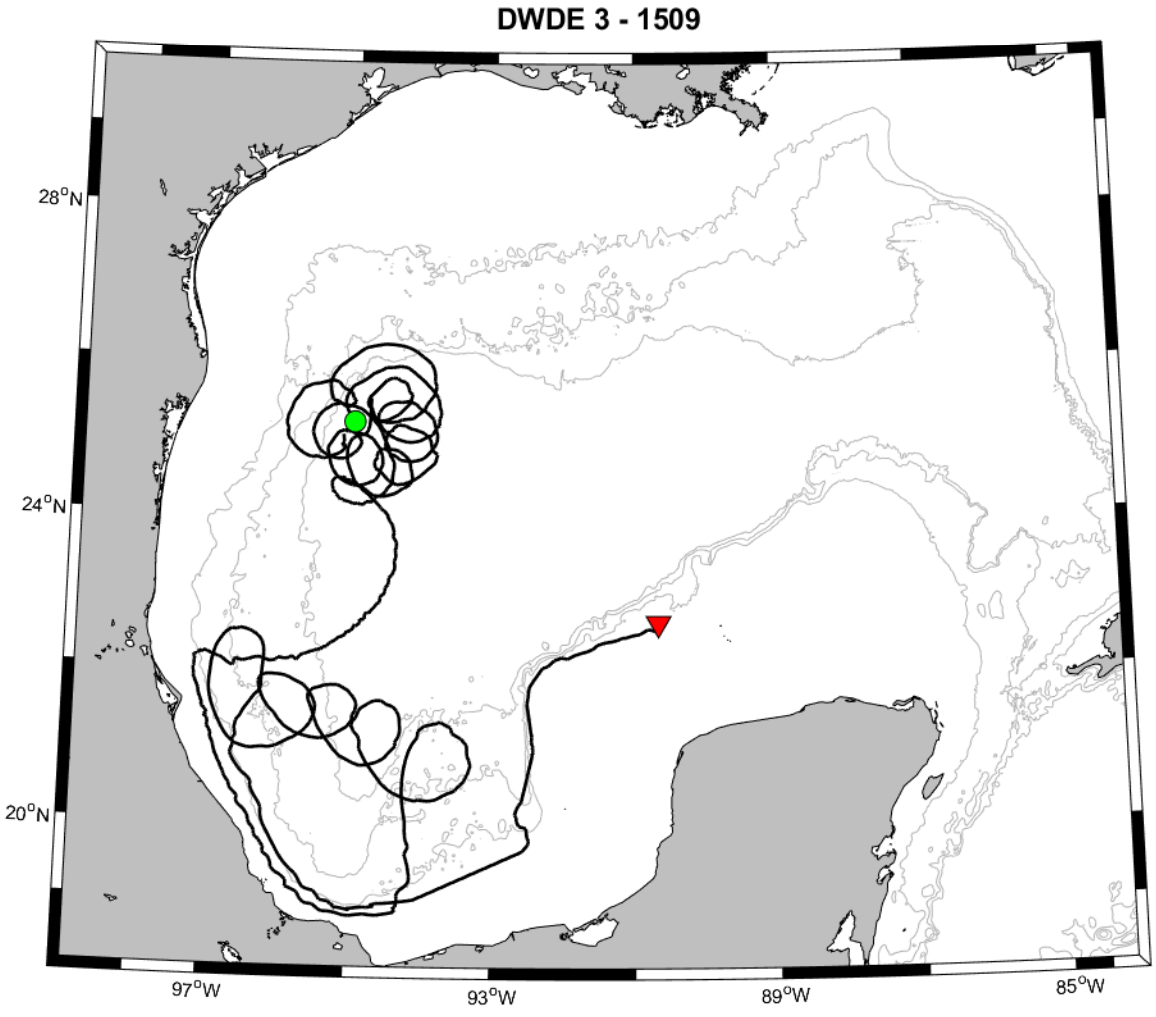

Float 1507 DWDE 3 (300-dbar)
temperature (℃)
13.8
11.8
9.8
pressure (db)
201
301
401
u-velocity (cm/s)
50
0
-50
v-velocity (cm/s)
50
0
-50
u-v velocity (cm/s)
50
0
-50
May 2017
Jul 2017
Sep 2017
Nov 2017
Jan 2018
Mar 2018
May 2018
Jul 2018
Sep 2018

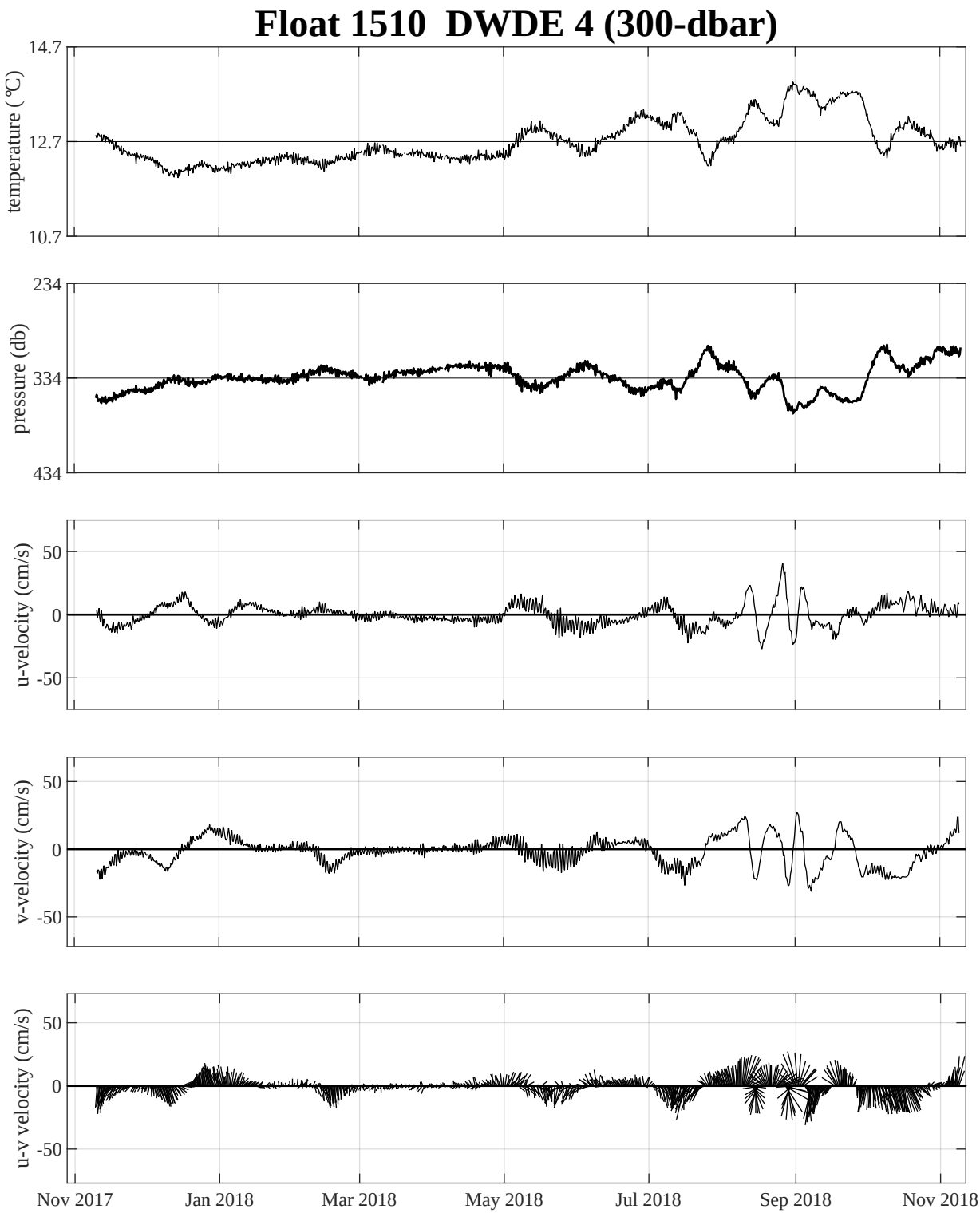

DWDE 3 - 1507
28°N
24°N
20°N
97°W
93°W
89°W
85°W

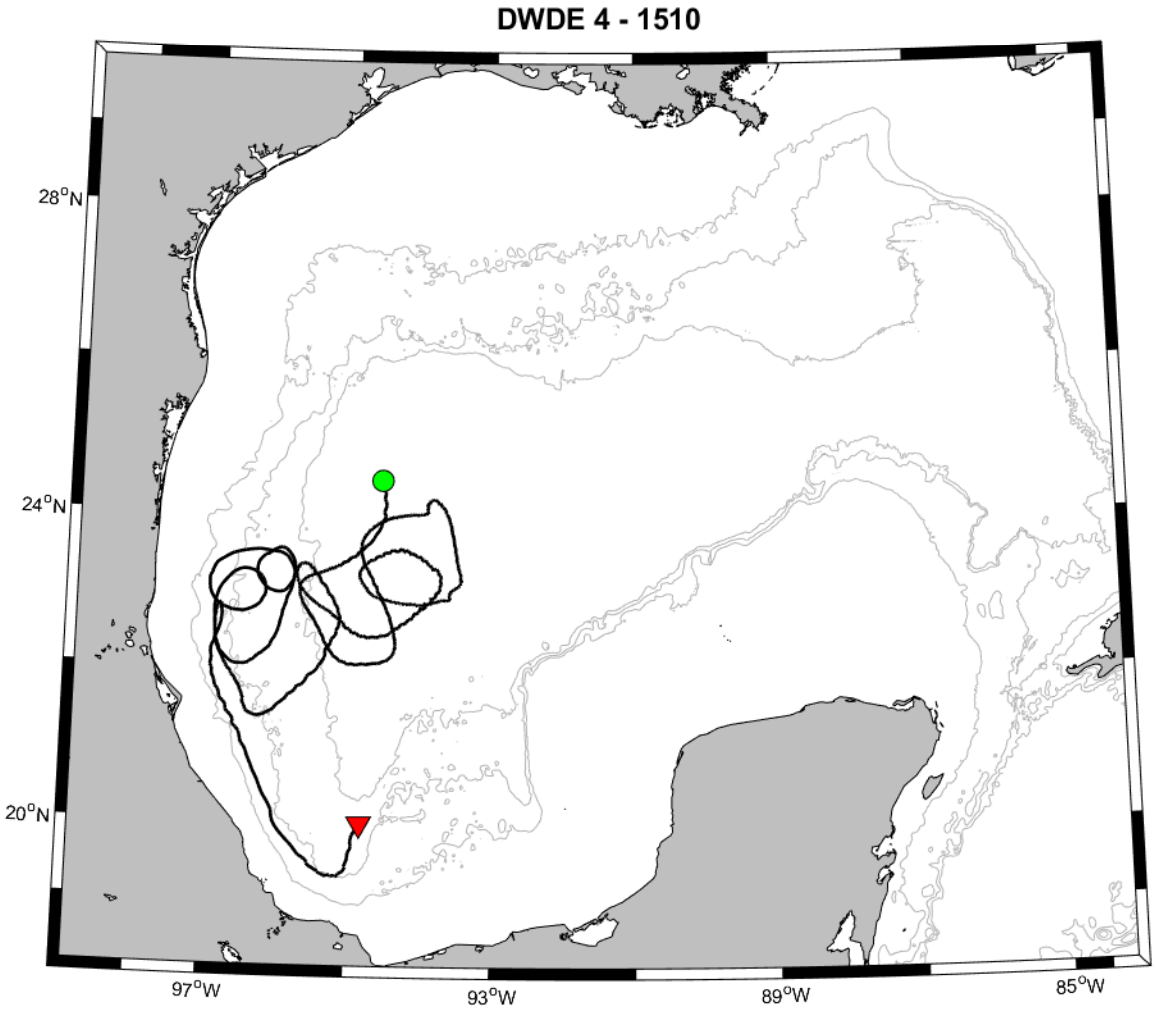

Float 1508 DWDE 3 (300-dbar)
temperature (℃)
15.1
13.1
11.1
pressure (db)
290
390
490
u-velocity (cm/s)
50
0
-50
v-velocity (cm/s)
50
0
-50
u-v velocity (cm/s)
50
0
-50
May 2017
Jul 2017
Sep 2017
Nov 2017
Jan 2018
Mar 2018
May 2018
Jul 2018
Sep 2018

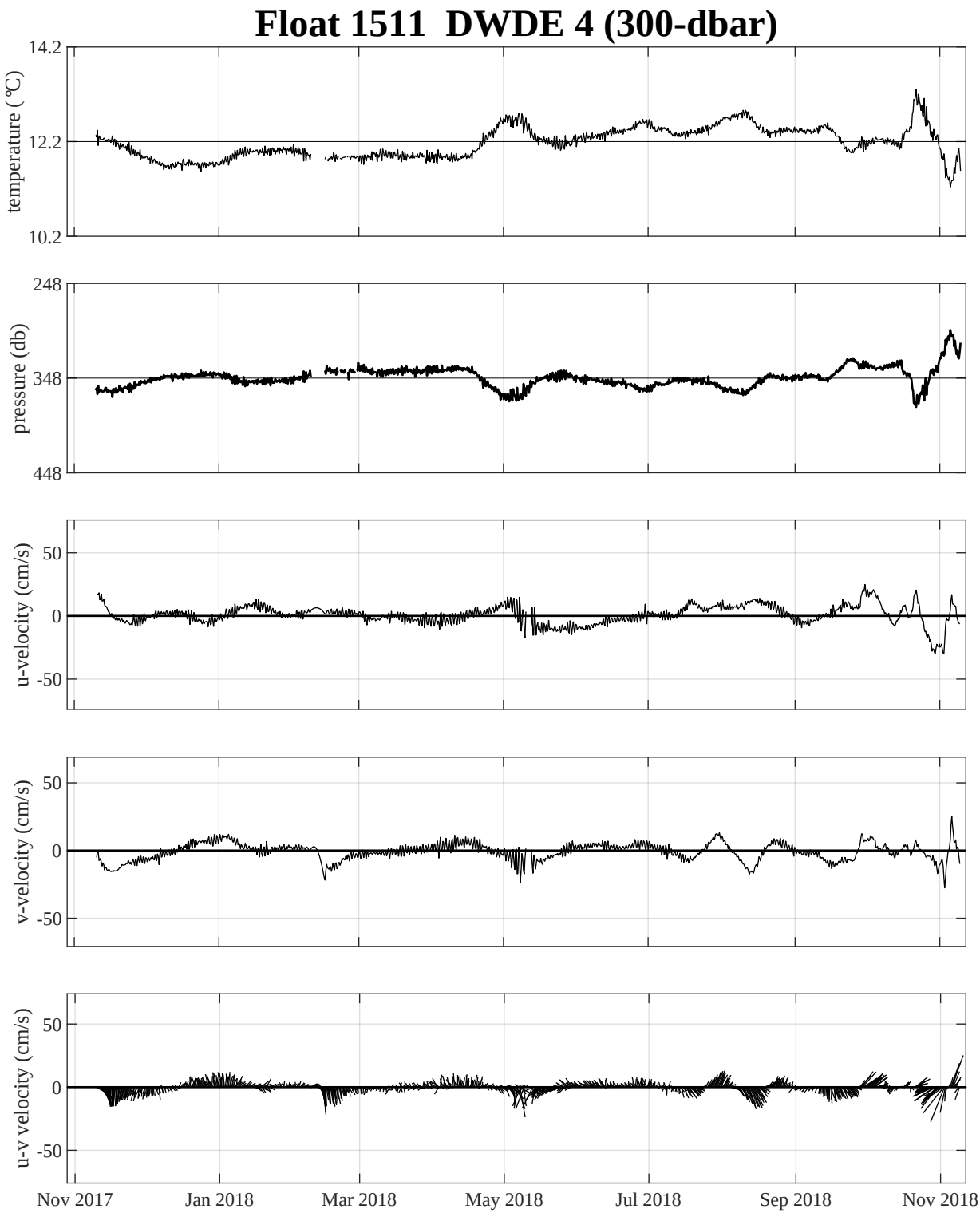

DWDE 3 - 1508
28°N
24°N
20°N
97°W
93°W
89°W
85°W

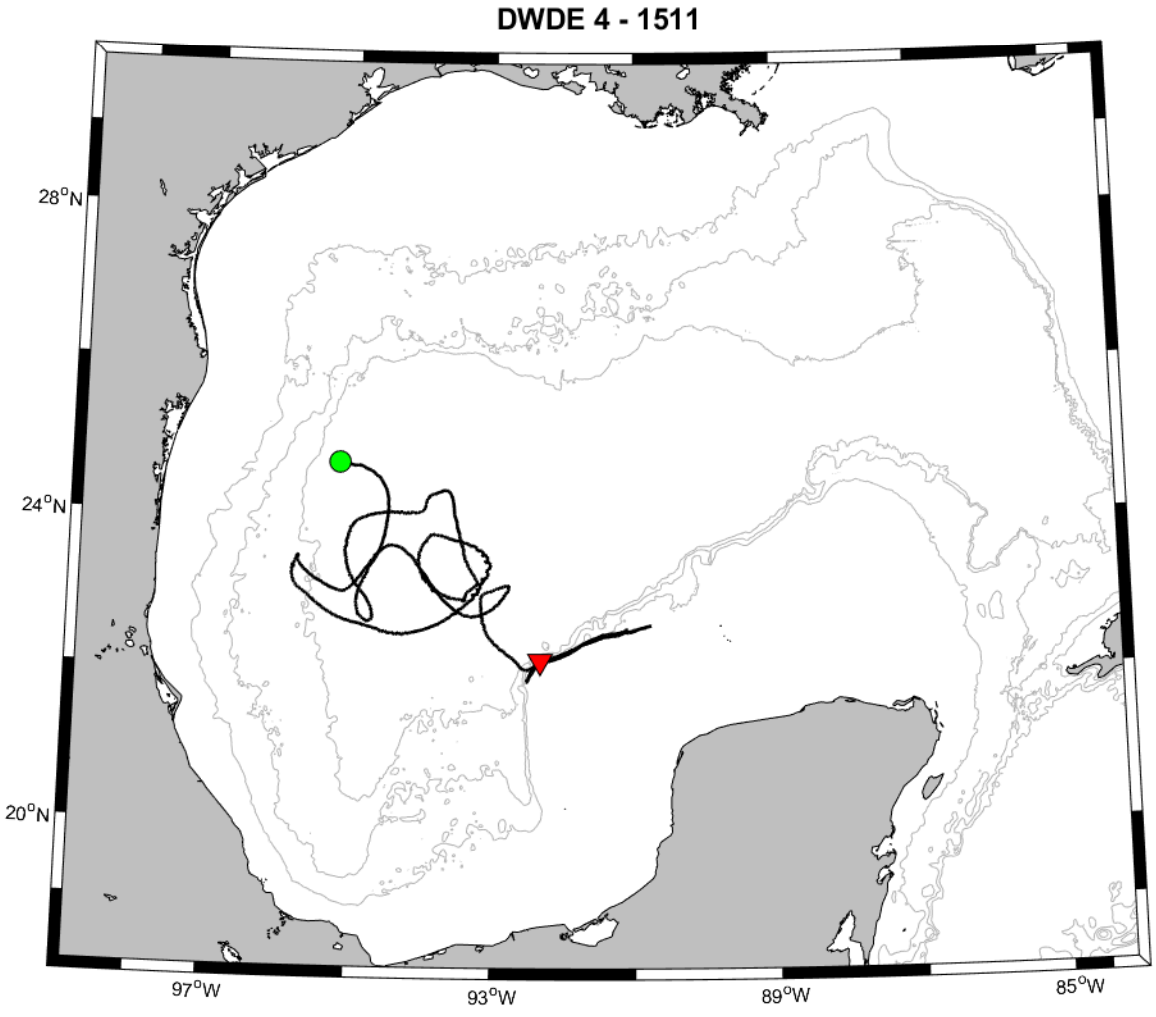

Float 1509 DWDE 3 (300-dbar)
temperature (℃)
18.8
16.8
14.8
pressure (db)
116
216
316
u-velocity (cm/s)
50
0
-50
v-velocity (cm/s)
50
0
-50
u-v velocity (cm/s)
50
0
-50
May 2017
Jul 2017
Sep 2017
Nov 2017
Jan 2018
Mar 2018
May 2018
Jul 2018
Sep 2018

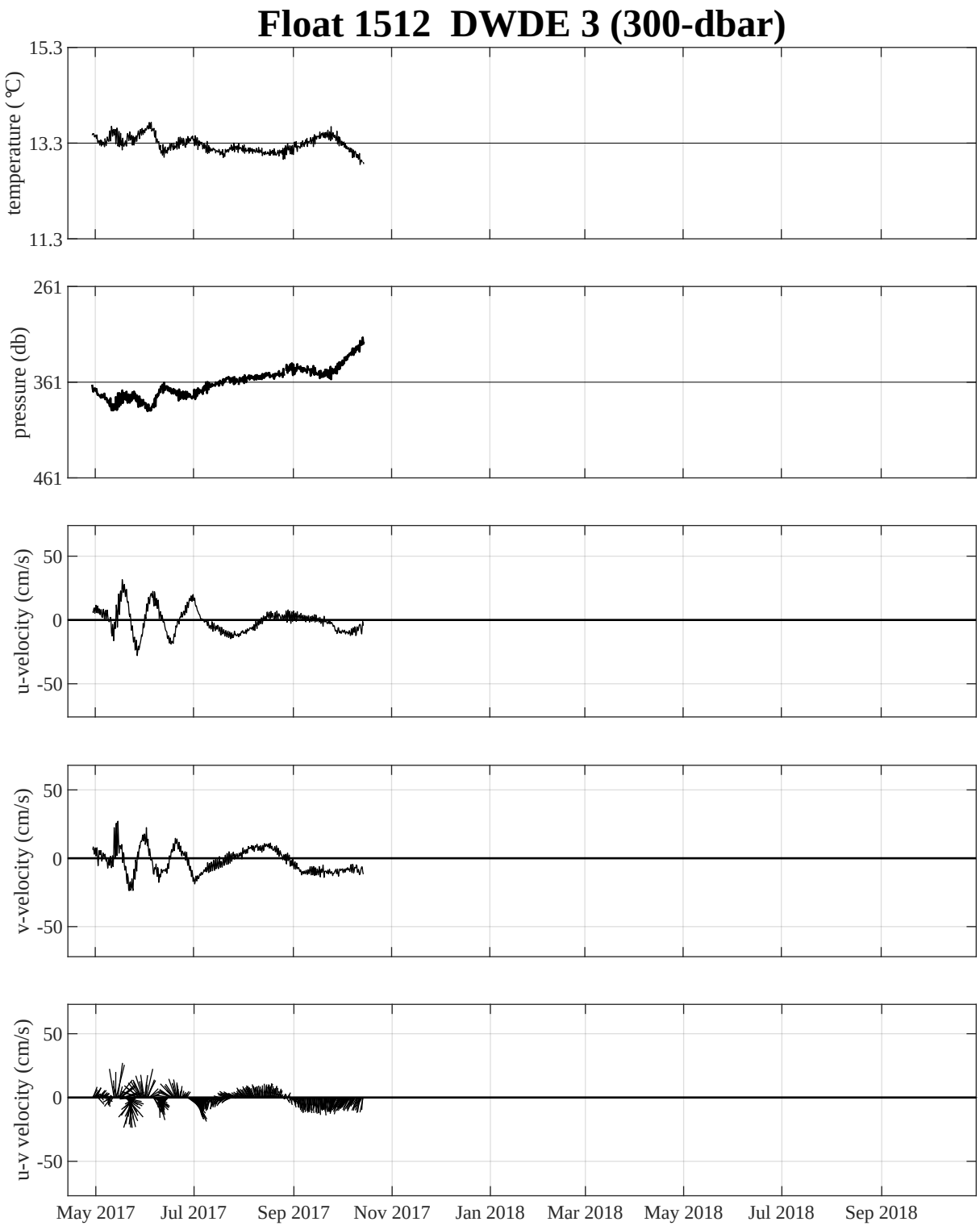

DWDE 3 - 1509
28°N
24°N
20°N
97°W
93°W
89°W
85°W

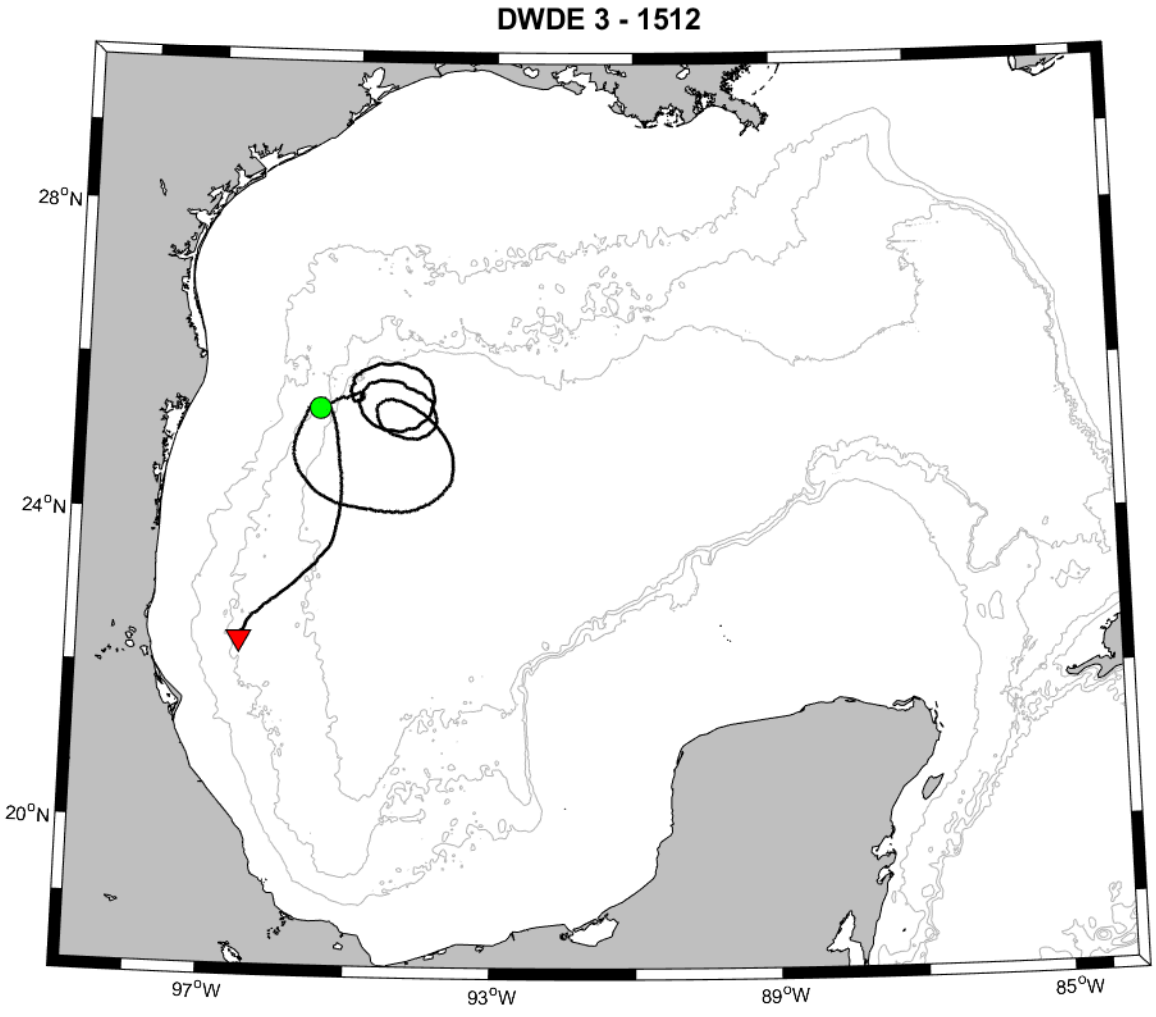

Float 1510 DWDE 4 (300-dbar)
temperature (℃)
14.7
12.7
10.7
pressure (db)
234
334
434
u-velocity (cm/s)
50
0
-50
v-velocity (cm/s)
50
0
-50
u-v velocity (cm/s)
50
0
-50
Nov 2017
Jan 2018
Mar 2018
May 2018
Jul 2018
Sep 2018
Nov 2018

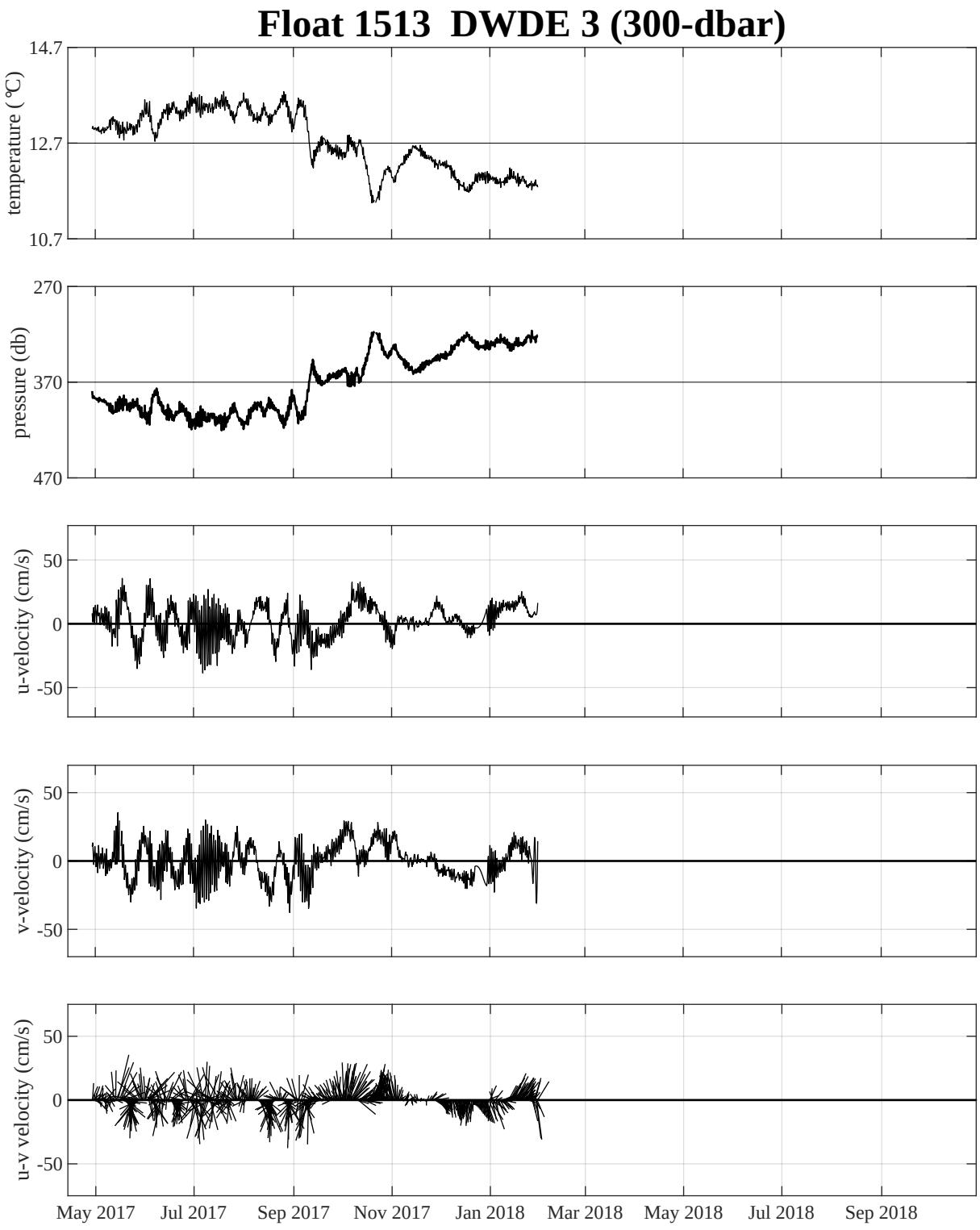

DWDE 4 - 1510
28°N
24°N
20°N
97°W
93°W
89°W
85°W

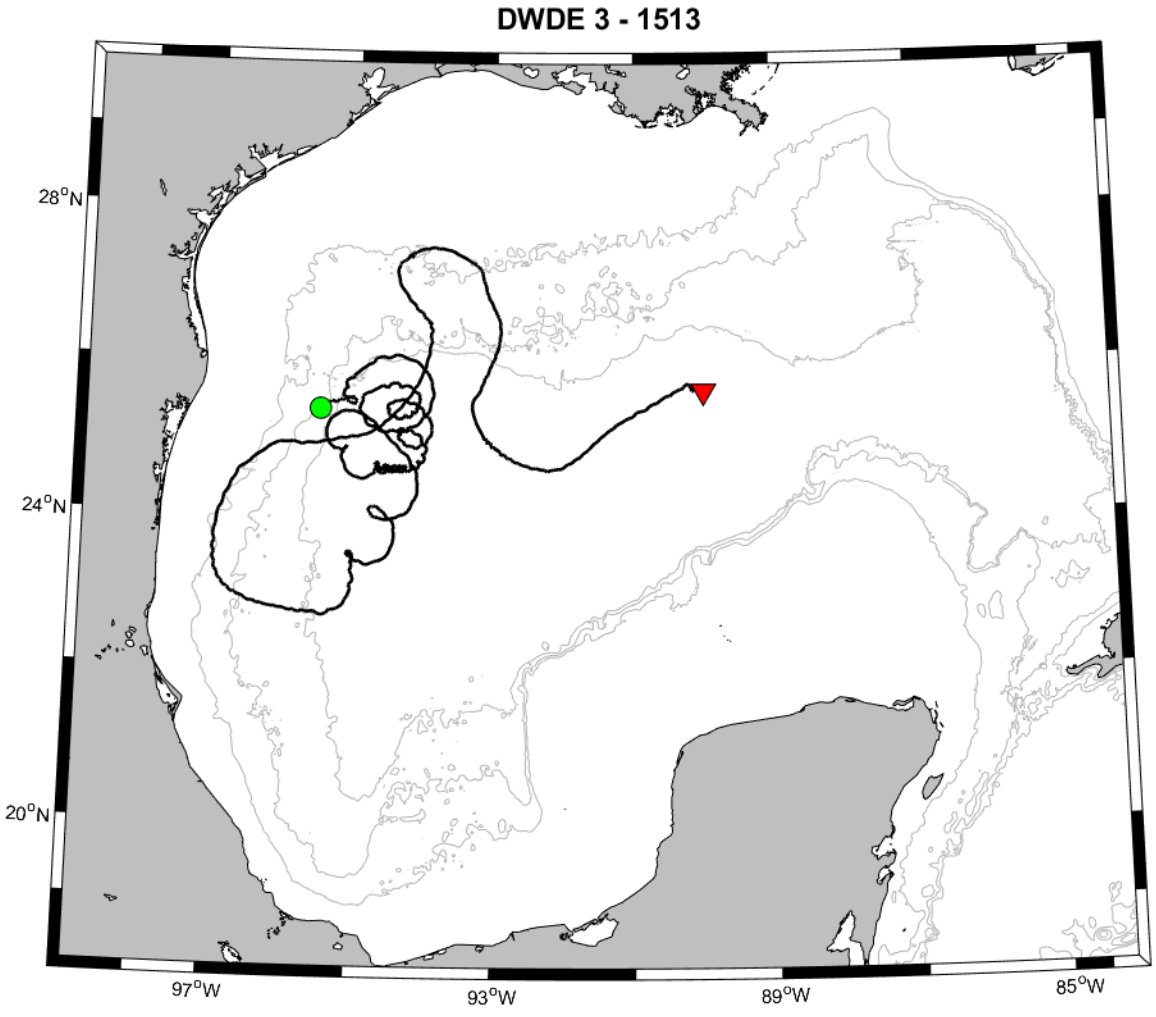

Float 1511 DWDE 4 (300-dbar)
temperature (℃)
14.2
12.2
10.2
pressure (db)
248
348
448
u-velocity (cm/s)
50
0
-50
v-velocity (cm/s)
50
0
-50
u-v velocity (cm/s)
50
0
-50
Nov 2017
Jan 2018
Mar 2018
May 2018
Jul 2018
Sep 2018
Nov 2018

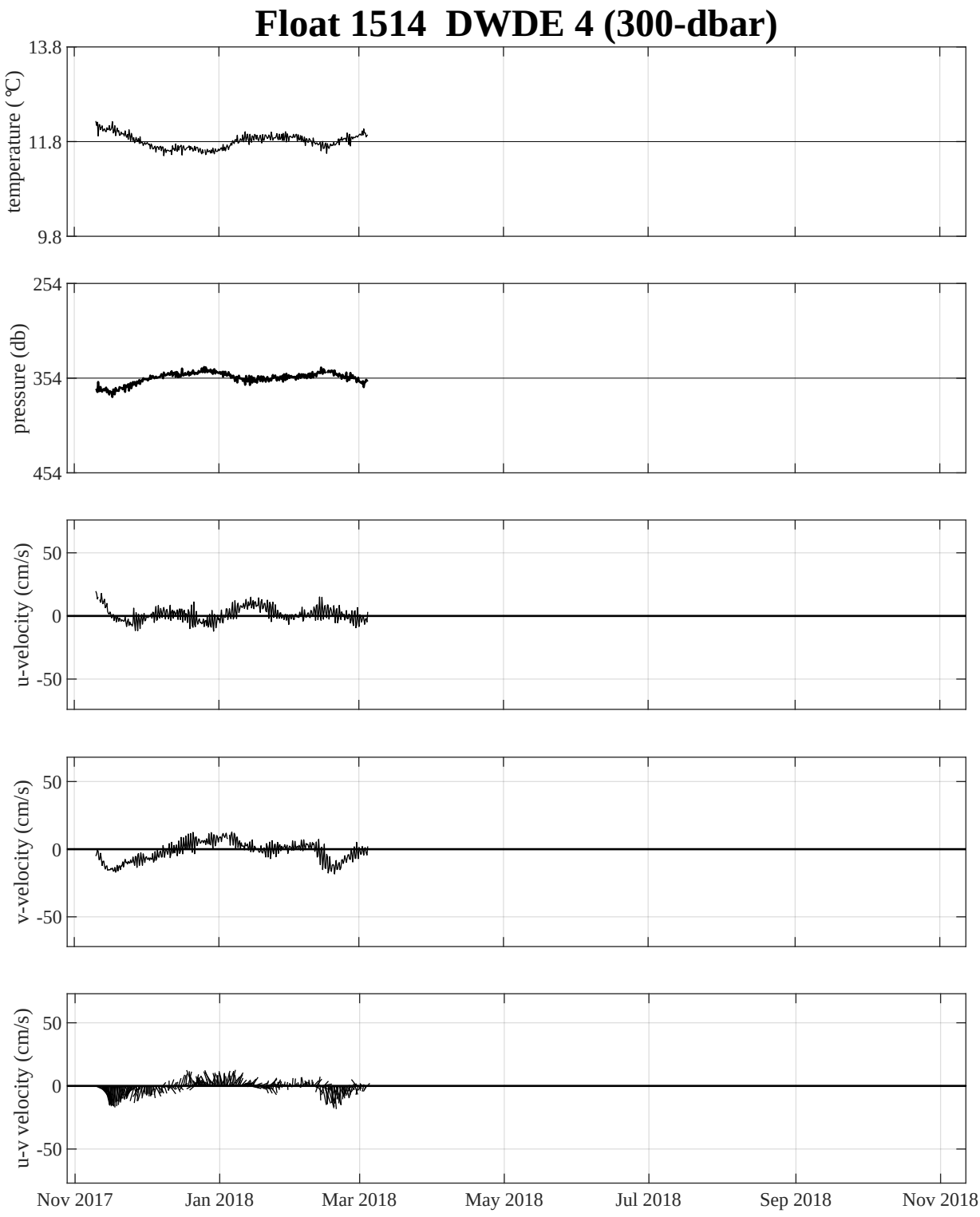

DWDE 4 - 1511
28°N
24°N
20°N
97°W
93°W
89°W
85°W

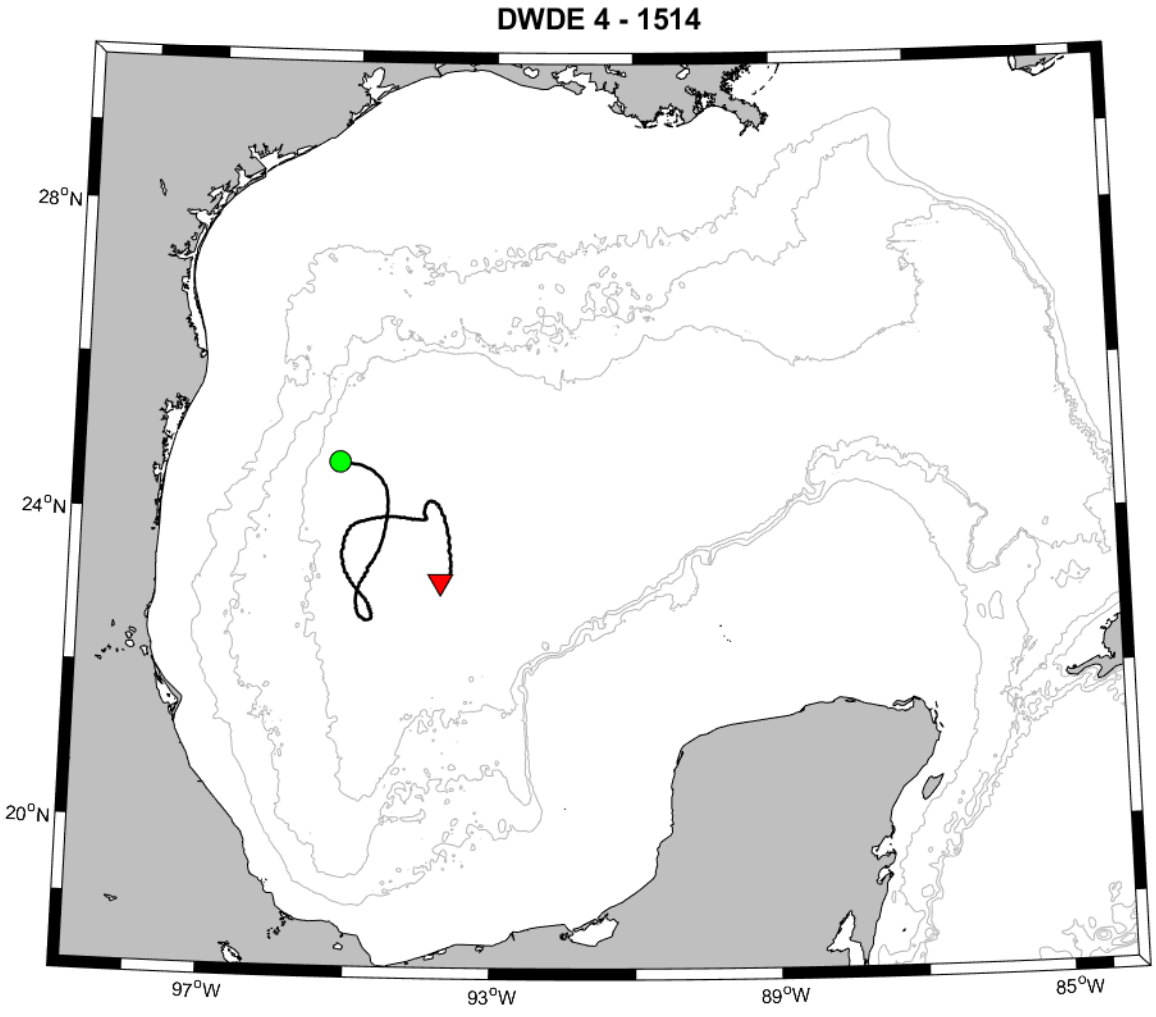

Float 1512 DWDE 3 (300-dbar)
temperature (℃)
15.3
13.3
11.3
pressure (db)
261
361
461
u-velocity (cm/s)
50
0
-50
v-velocity (cm/s)
50
0
-50
u-v velocity (cm/s)
50
0
-50
May 2017
Jul 2017
Sep 2017
Nov 2017
Jan 2018
Mar 2018
May 2018
Jul 2018
Sep 2018

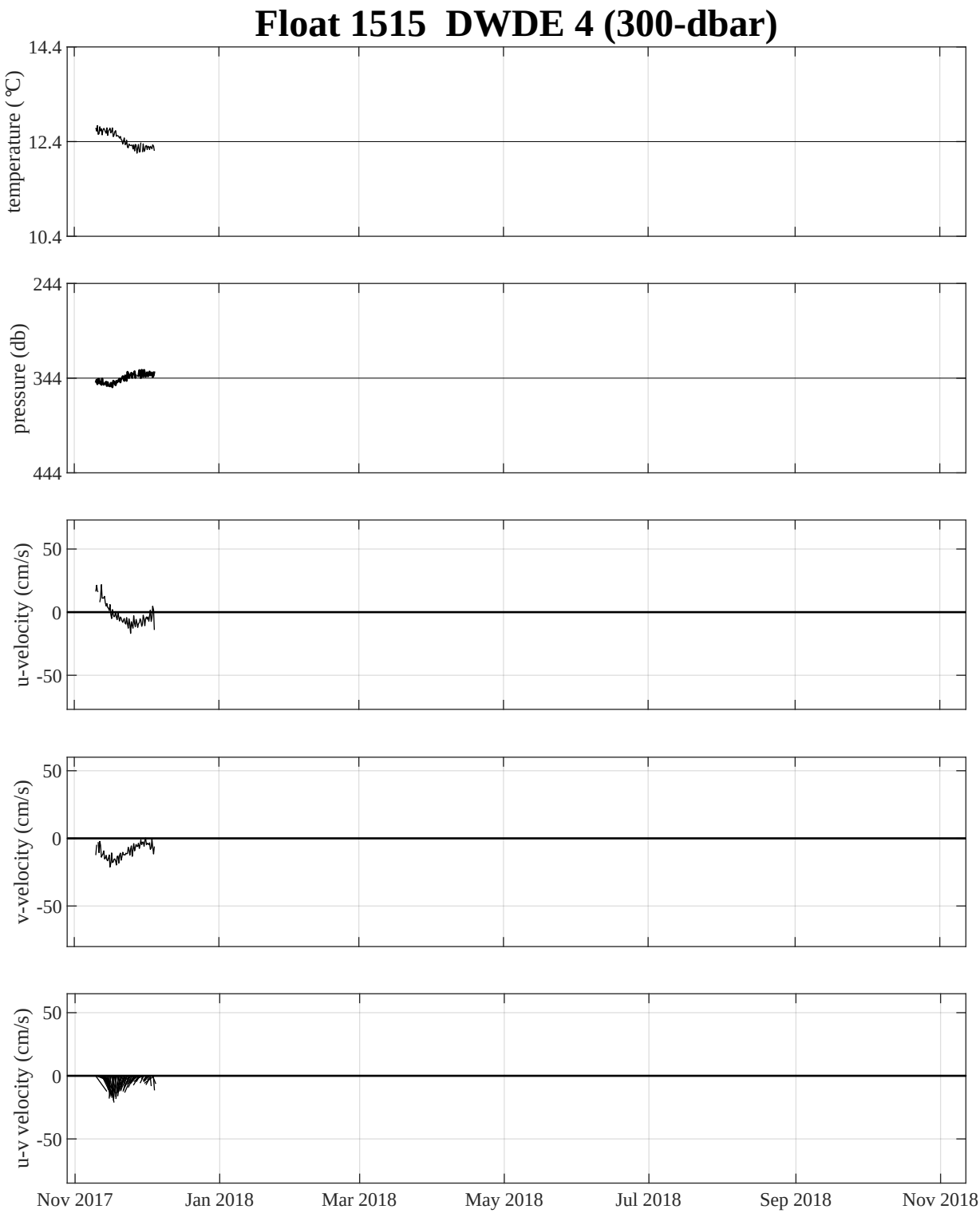

DWDE 3 - 1512
28°N
24°N
20°N
97°W
93°W
89°W
85°W

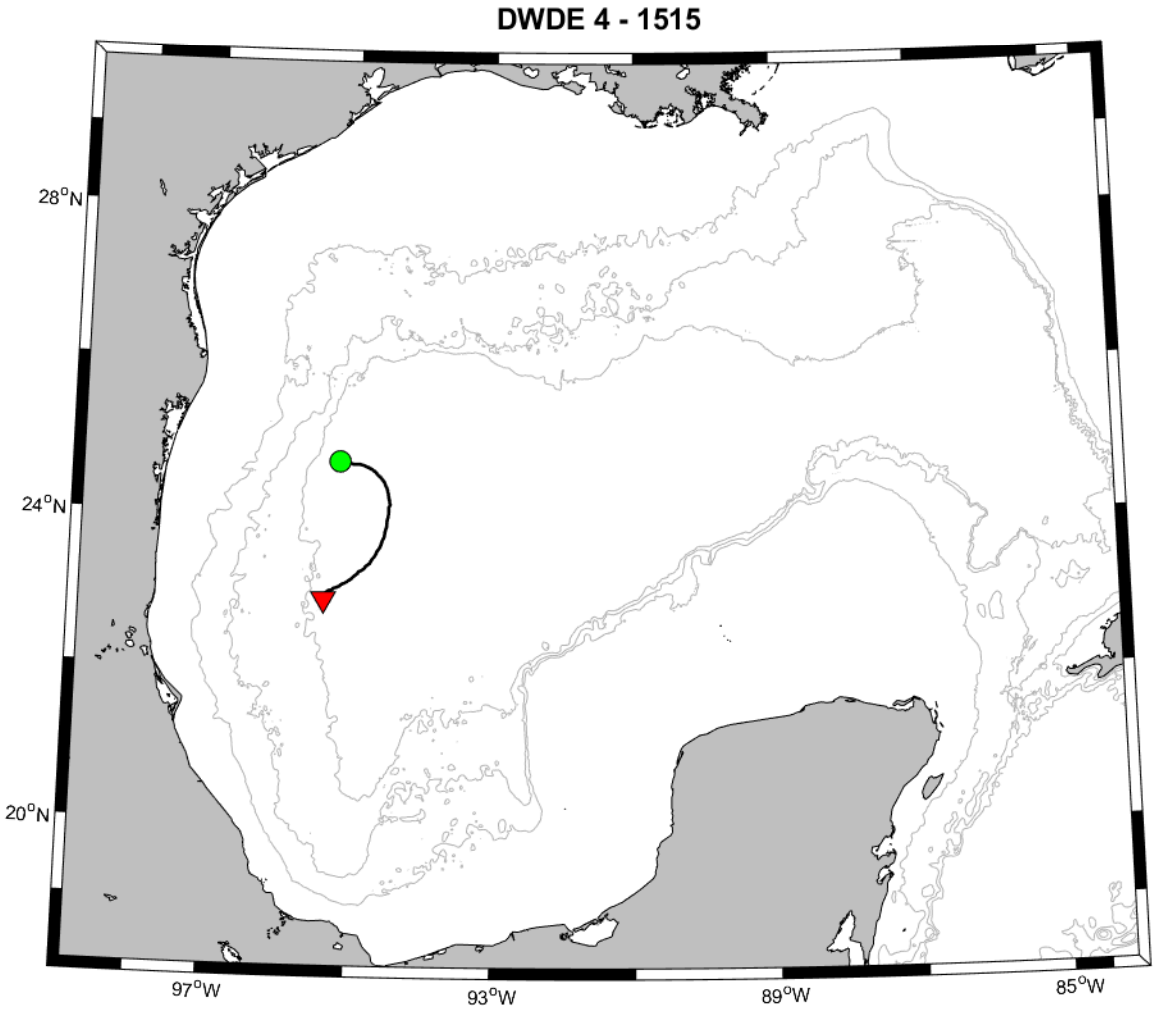

Float 1513 DWDE 3 (300-dbar)
temperature (℃)
14.7
12.7
10.7
pressure (db)
270
370
470
u-velocity (cm/s)
50
0
-50
v-velocity (cm/s)
50
0
-50
u-v velocity (cm/s)
50
0
-50
May 2017
Jul 2017
Sep 2017
Nov 2017
Jan 2018
Mar 2018
May 2018
Jul 2018
Sep 2018

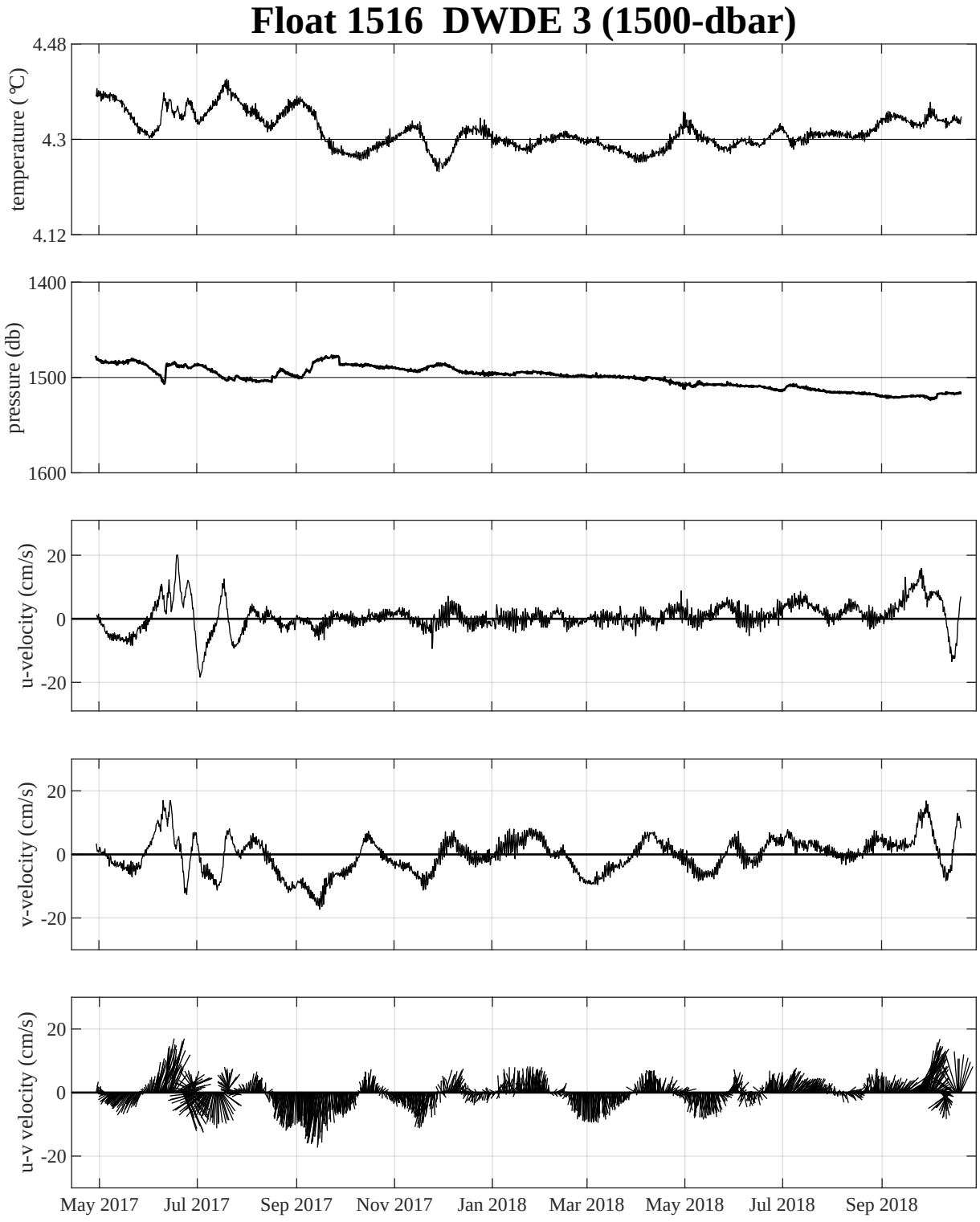

DWDE 3 - 1513
28°N
24°N
20°N
97°W
93°W
89°W
85°W

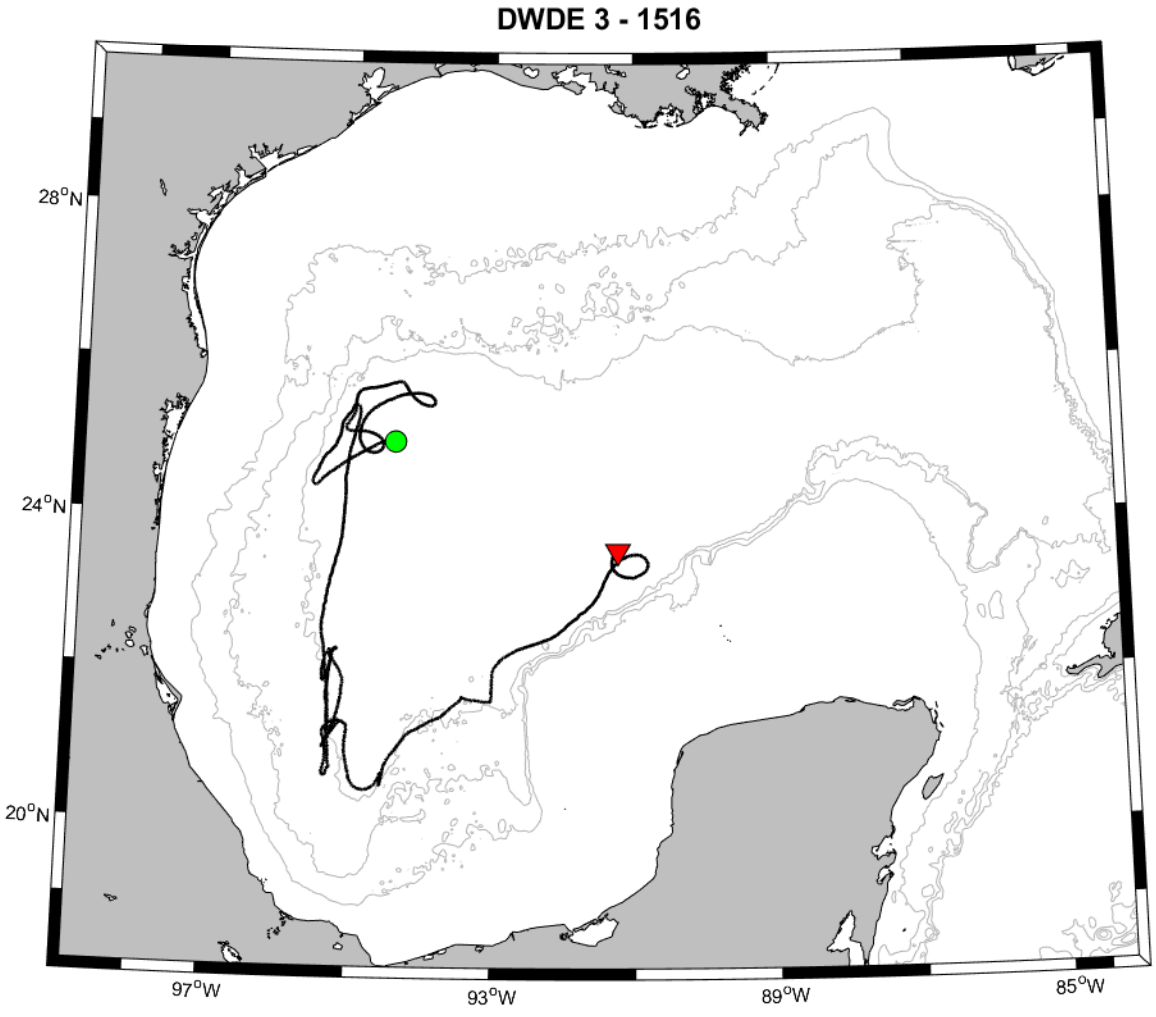

Float 1514 DWDE 4 (300-dbar)
temperature (℃)
13.8
11.8
9.8
pressure (db)
254
354
454
u-velocity (cm/s)
50
0
-50
v-velocity (cm/s)
50
0
-50
u-v velocity (cm/s)
50
0
-50
Nov 2017
Jan 2018
Mar 2018
May 2018
Jul 2018
Sep 2018
Nov 2018

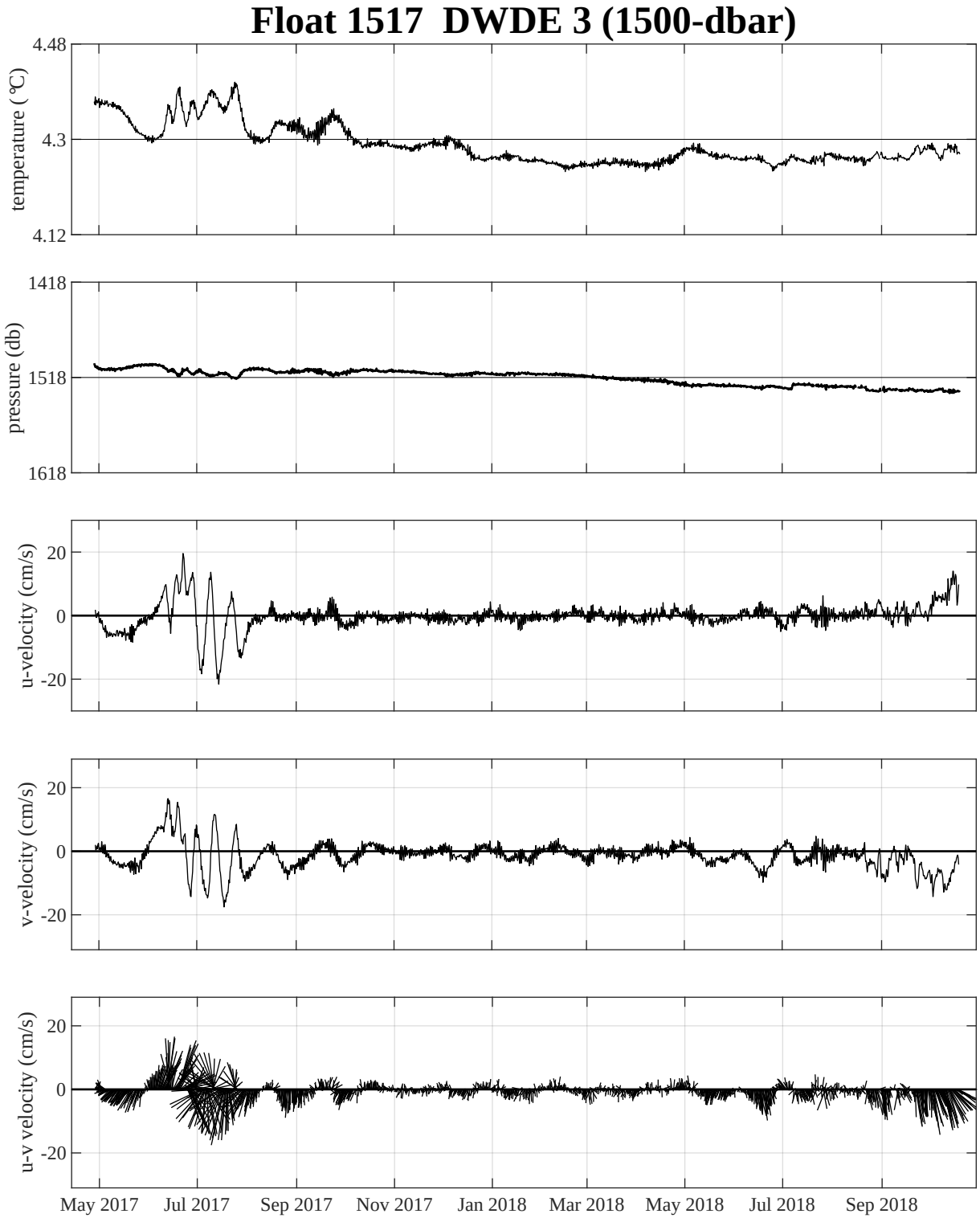

DWDE 4 - 1514
28°N
24°N
20°N
97°W
93°W
89°W
85°W

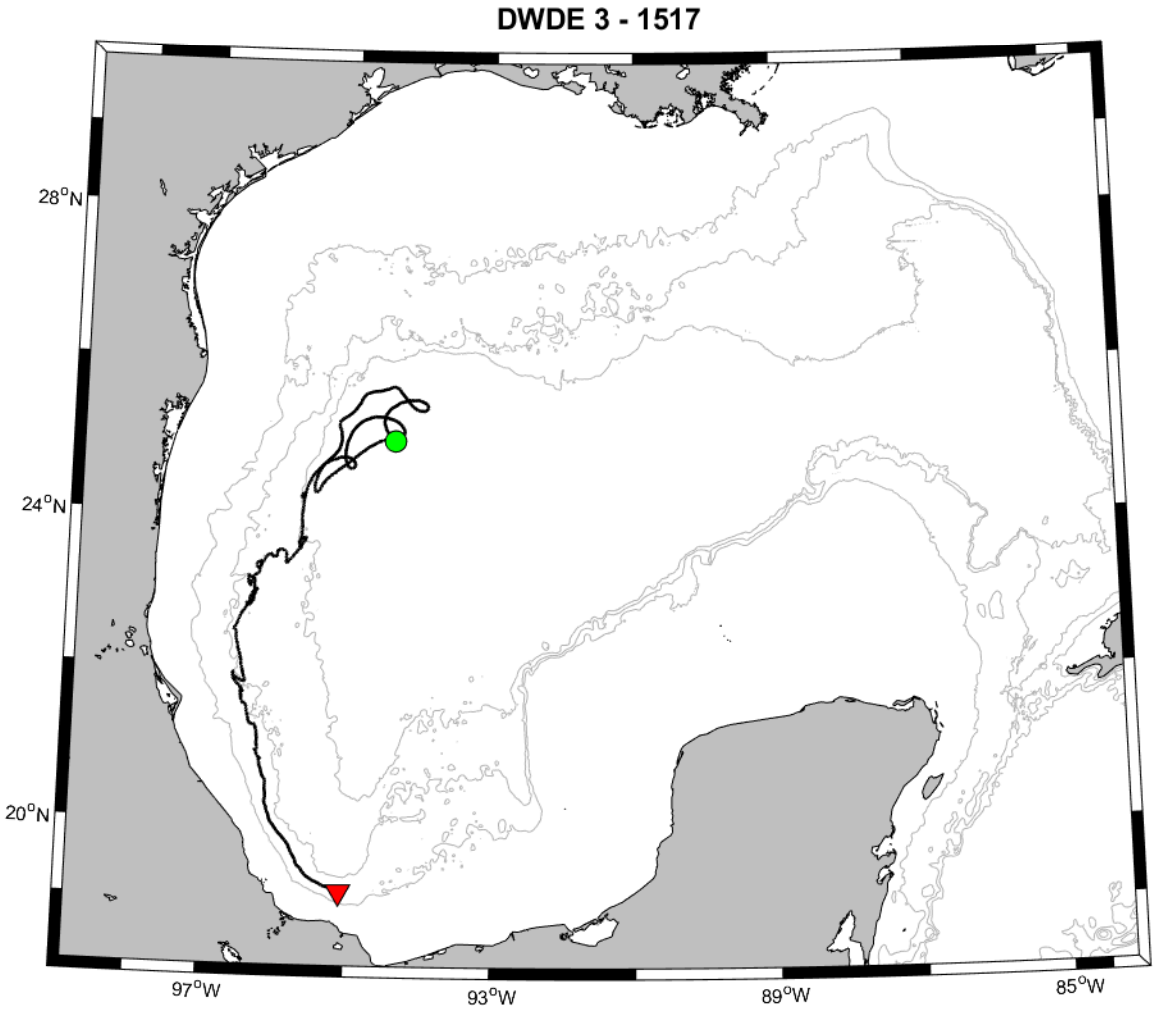

Float 1515 DWDE 4 (300-dbar)
temperature (℃)
14.4
12.4
10.4
pressure (db)
244
344
444
u-velocity (cm/s)
50
0
-50
v-velocity (cm/s)
50
0
-50
u-v velocity (cm/s)
50
0
-50
Nov 2017
Jan 2018
Mar 2018
May 2018
Jul 2018
Sep 2018
Nov 2018

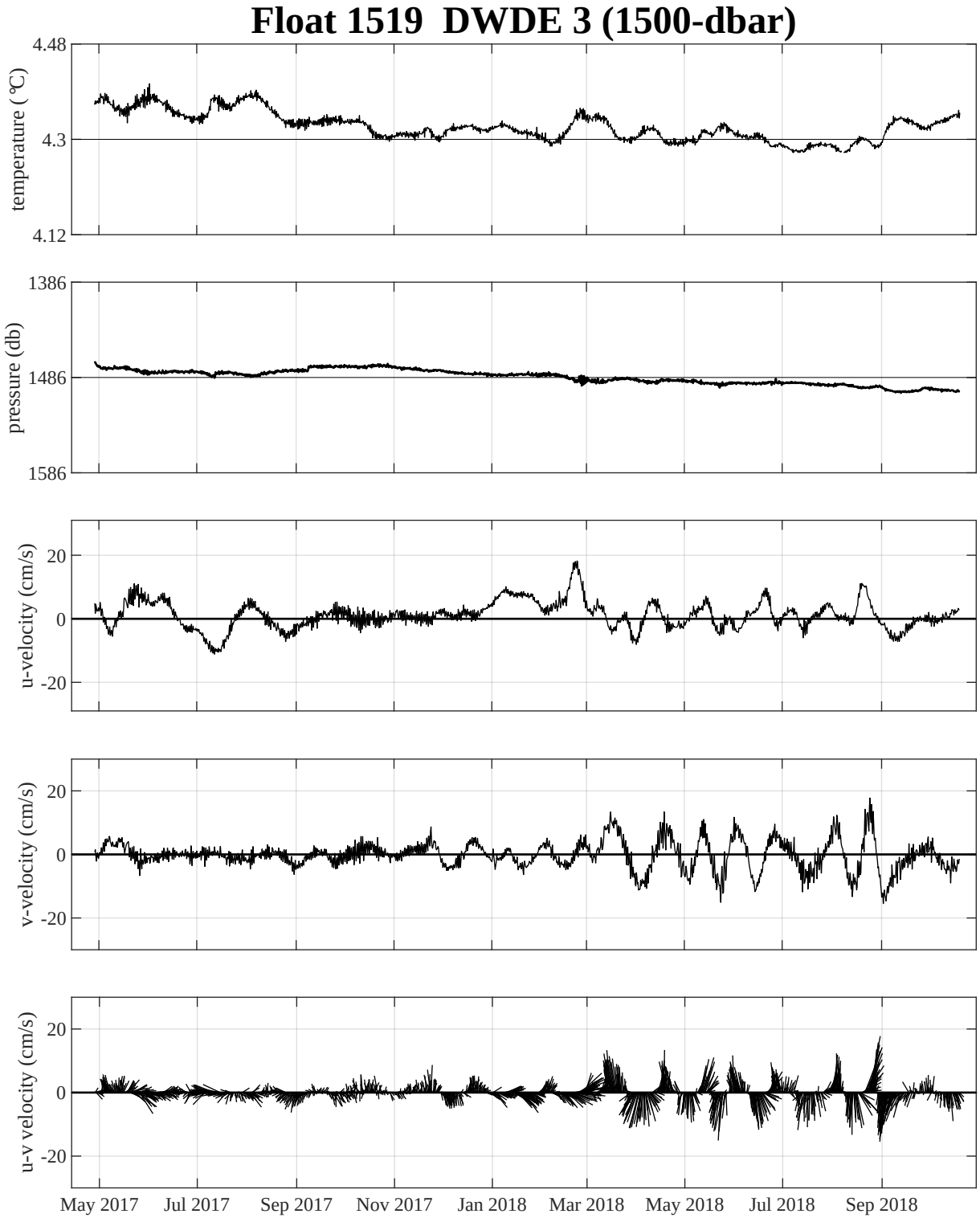

DWDE 4 - 1515
28°N
24°N
20°N
97°W
93°W
89°W
85°W

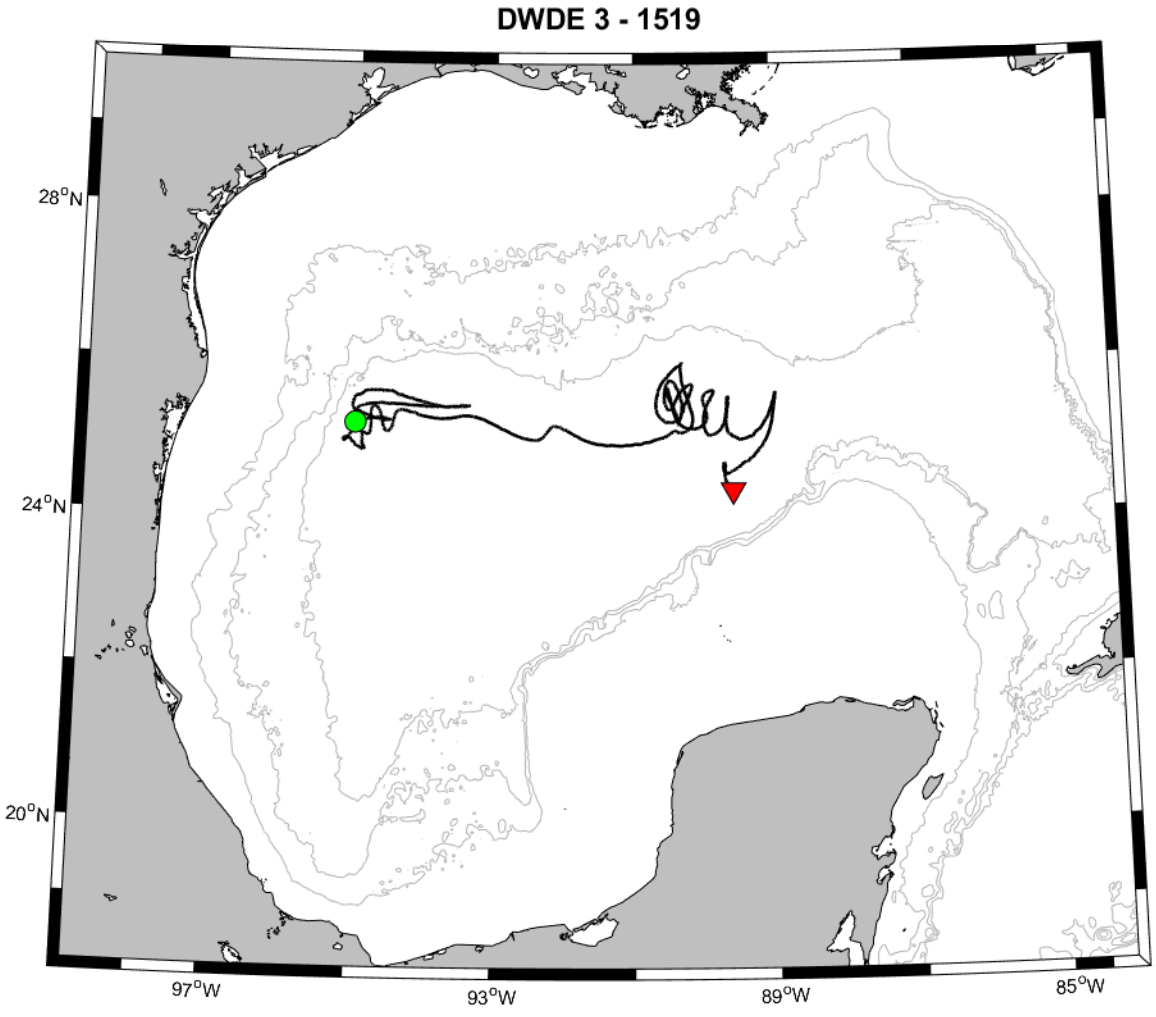

Float 1516 DWDE 3 (1500-dbar)
temperature (℃)
4.48
4.3
4.12
pressure (db)
1400
1500
1600
u-velocity (cm/s)
20
0
-20
v-velocity (cm/s)
20
0
-20
u-v velocity (cm/s)
20
0
-20
May 2017
Jul 2017
Sep 2017
Nov 2017
Jan 2018
Mar 2018
May 2018
Jul 2018
Sep 2018

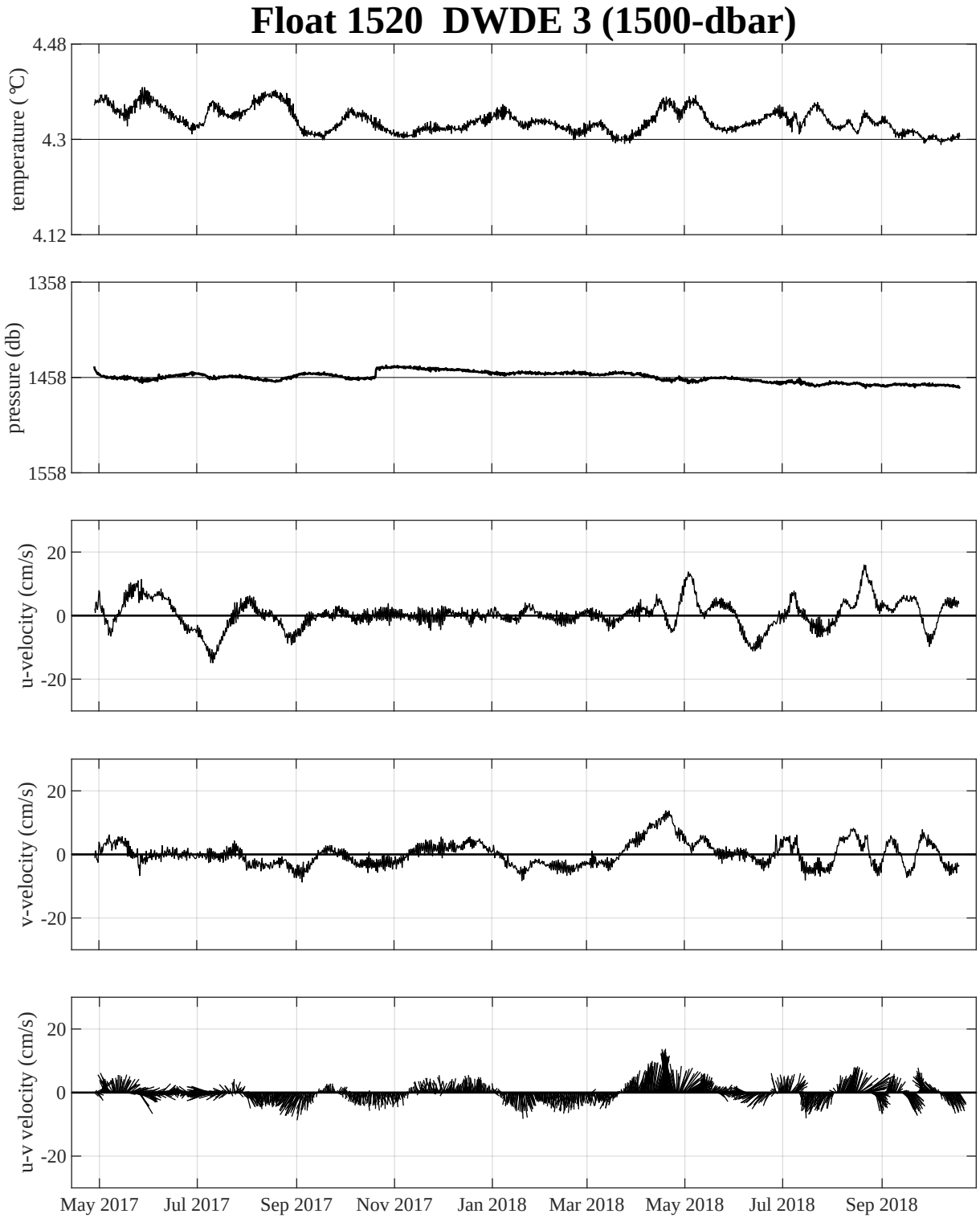

DWDE 3 - 1516
28°N
24°N
20°N
97°W
93°W
89°W
85°W

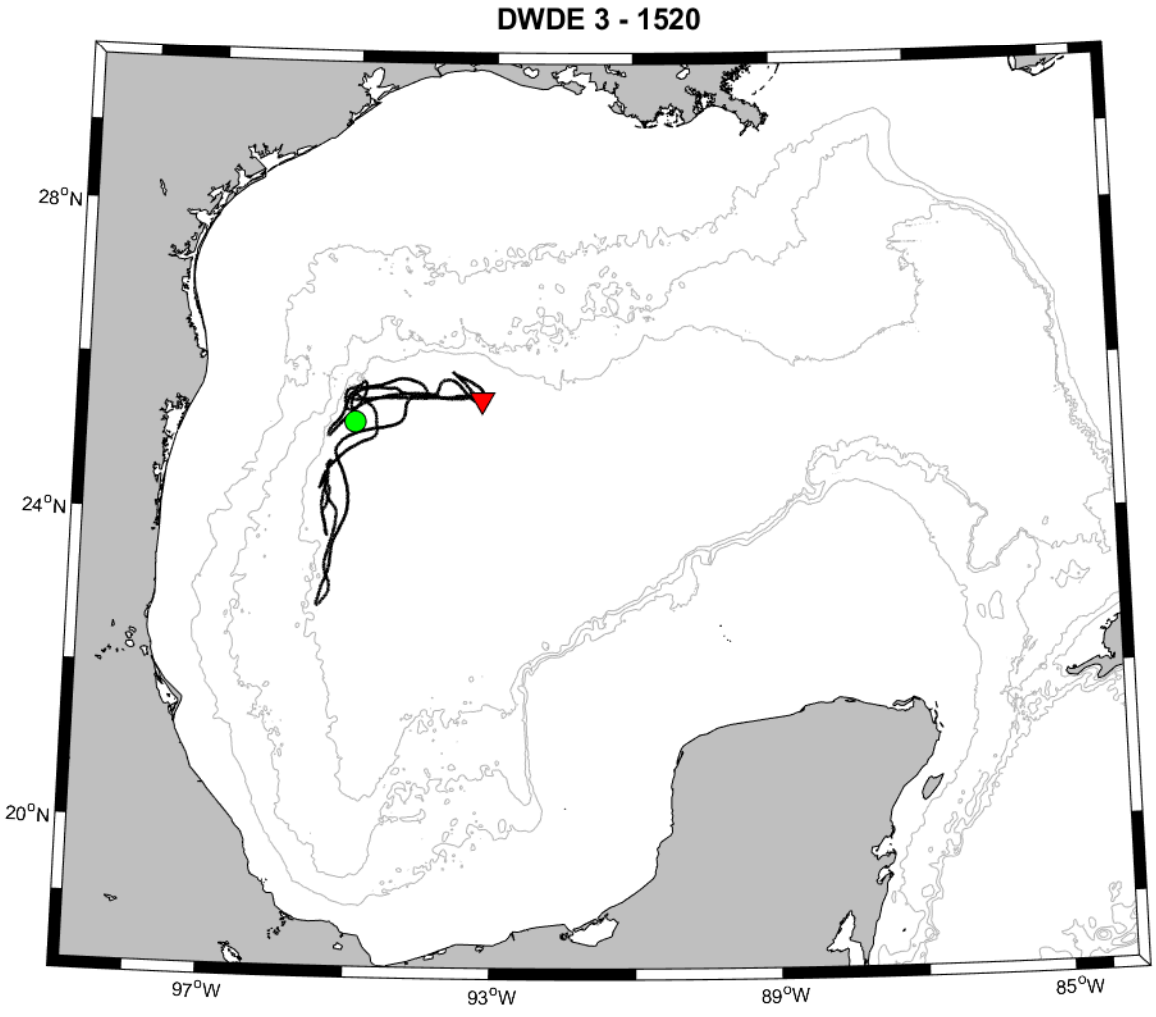

Float 1517 DWDE 3 (1500-dbar)
temperature (℃)
4.48
4.3
4.12
pressure (db)
1418
1518
1618
u-velocity (cm/s)
20
0
-20
v-velocity (cm/s)
20
0
-20
u-v velocity (cm/s)
20
0
-20
May 2017
Jul 2017
Sep 2017
Nov 2017
Jan 2018
Mar 2018
May 2018
Jul 2018
Sep 2018

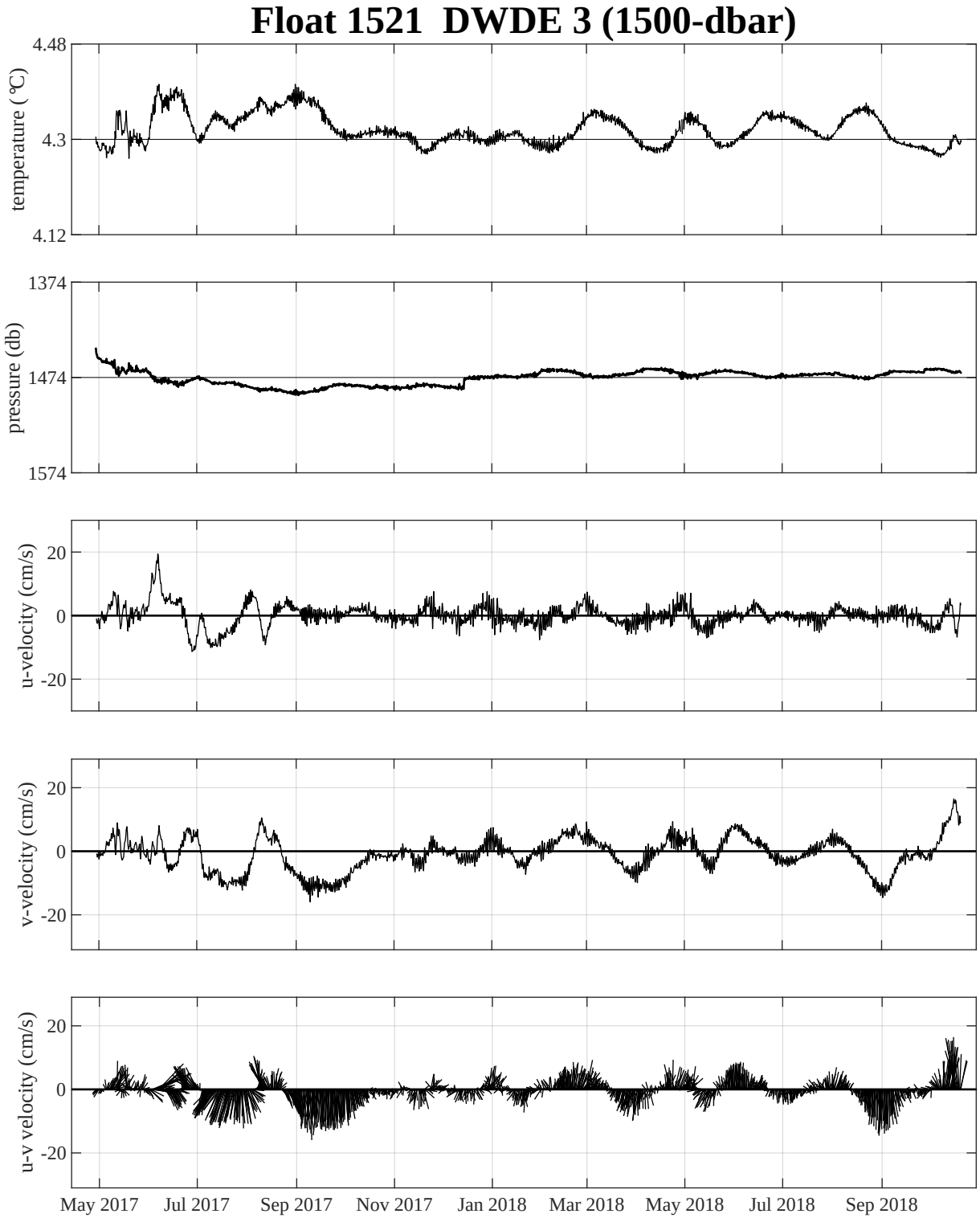

DWDE 3 - 1517
28°N
24°N
20°N
97°W
93°W
89°W
85°W

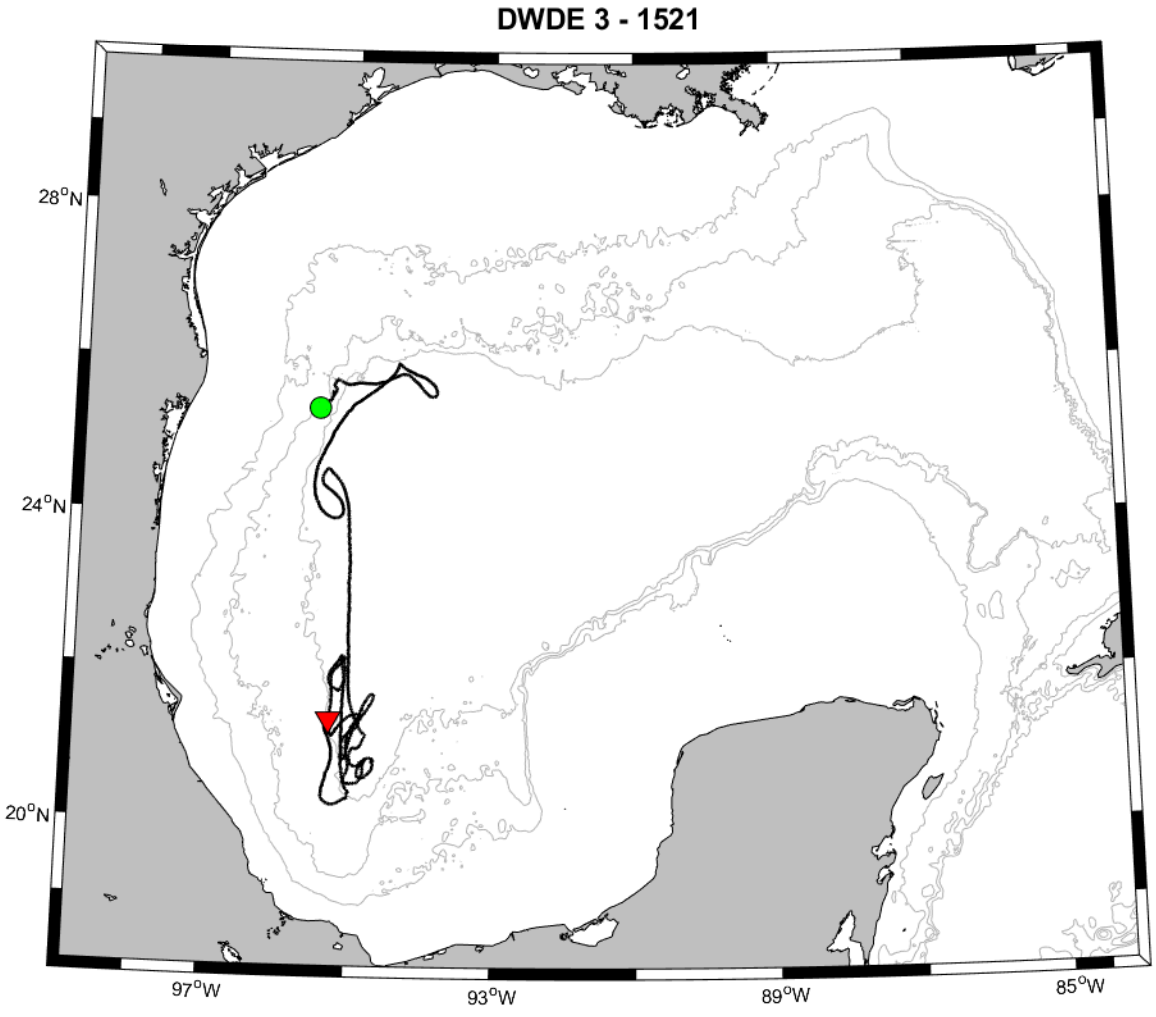

Float 1519 DWDE 3 (1500-dbar)
temperature (℃)
4.48
4.3
4.12
pressure (db)
1386
1486
1586
u-velocity (cm/s)
20
0
-20
v-velocity (cm/s)
20
0
-20
u-v velocity (cm/s)
20
0
-20
May 2017
Jul 2017
Sep 2017
Nov 2017
Jan 2018
Mar 2018
May 2018
Jul 2018
Sep 2018

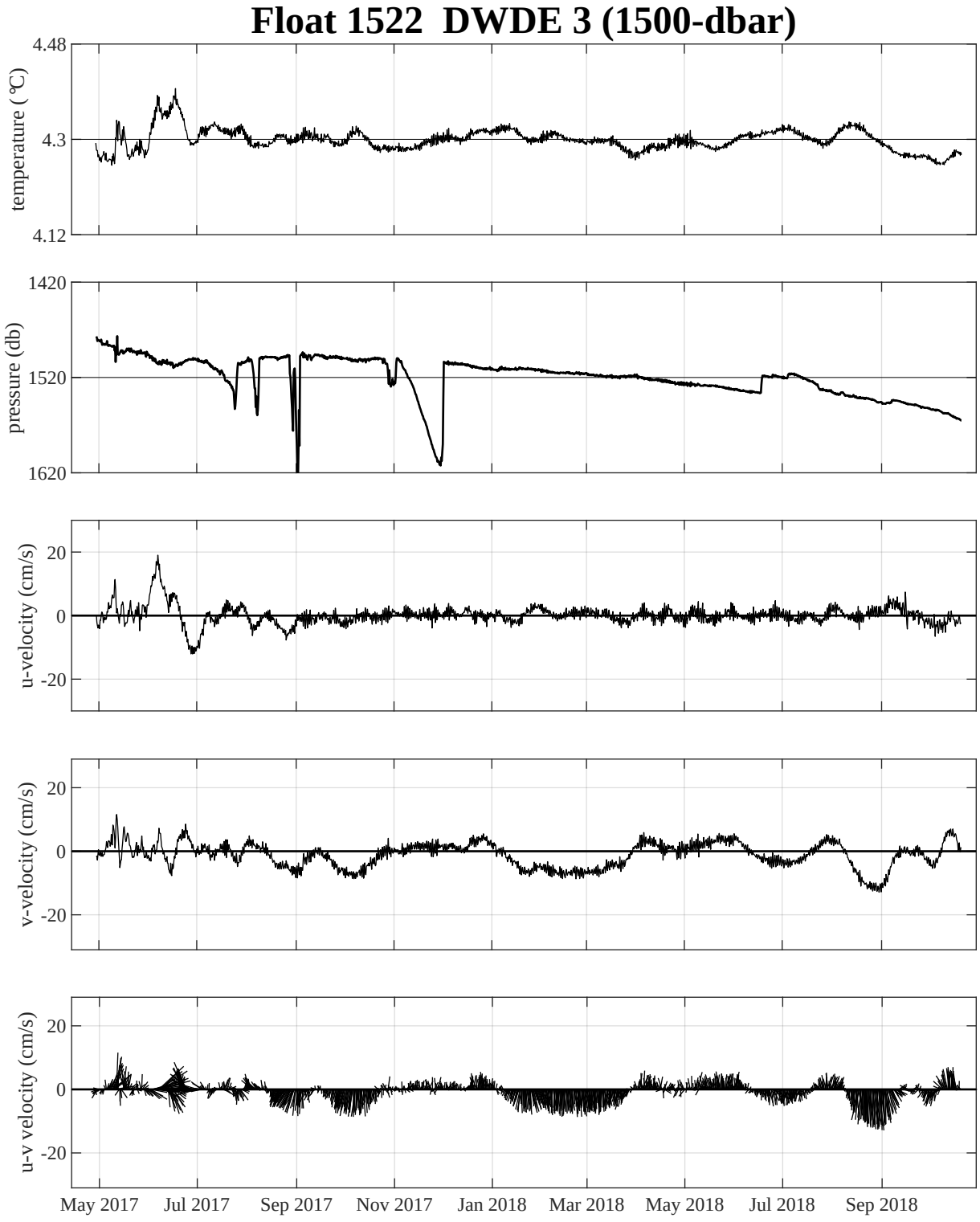

DWDE 3 - 1519
28°N
24°N
20°N
97°W
93°W
89°W
85°W

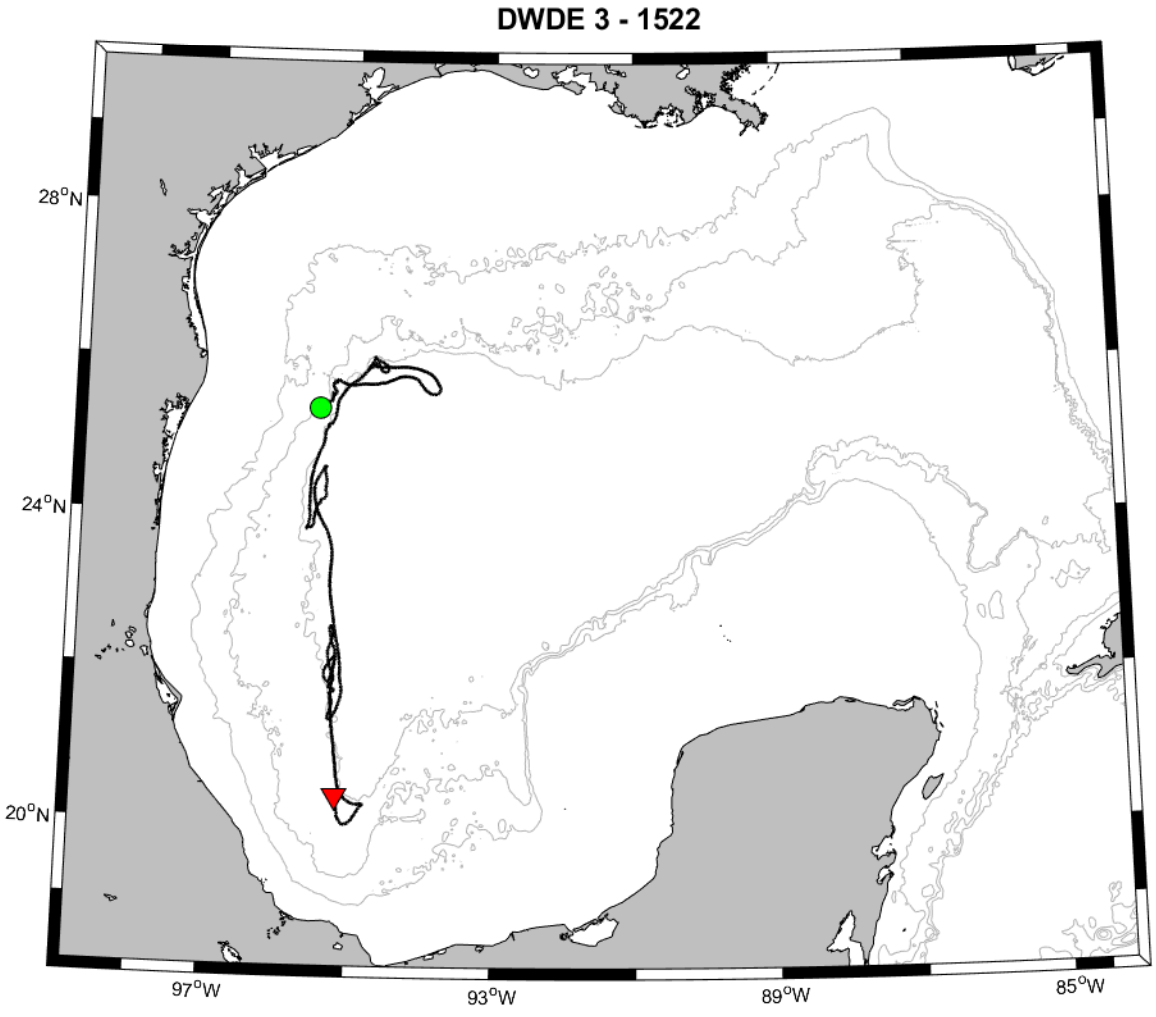

Float 1520 DWDE 3 (1500-dbar)
temperature (℃)
4.48
4.3
4.12
pressure (db)
1358
1458
1558
u-velocity (cm/s)
20
0
-20
v-velocity (cm/s)
20
0
-20
u-v velocity (cm/s)
20
0
-20
May 2017
Jul 2017
Sep 2017
Nov 2017
Jan 2018
Mar 2018
May 2018
Jul 2018
Sep 2018

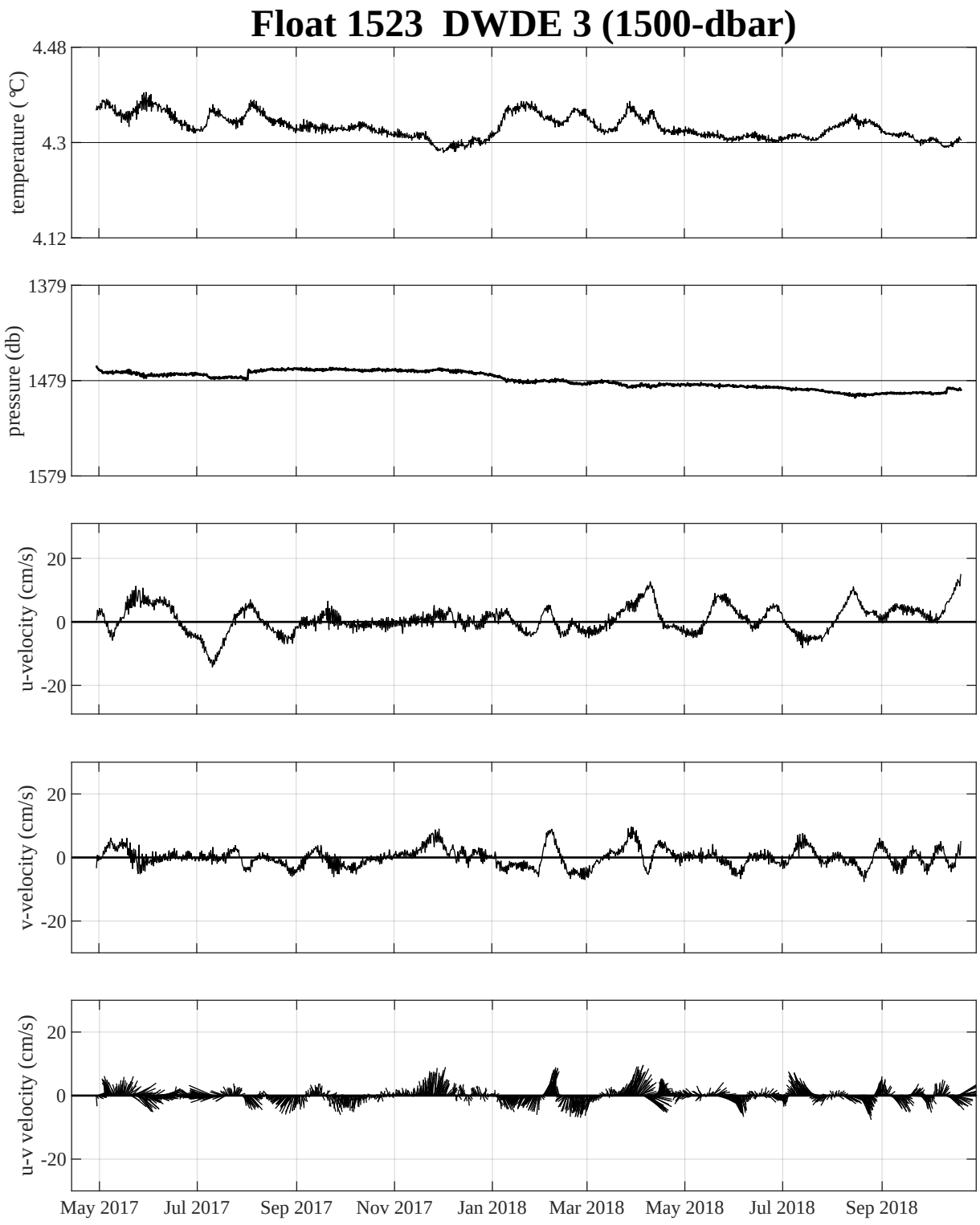

DWDE 3 - 1520
28°N
24°N
20°N
97°W
93°W
89°W
85°W

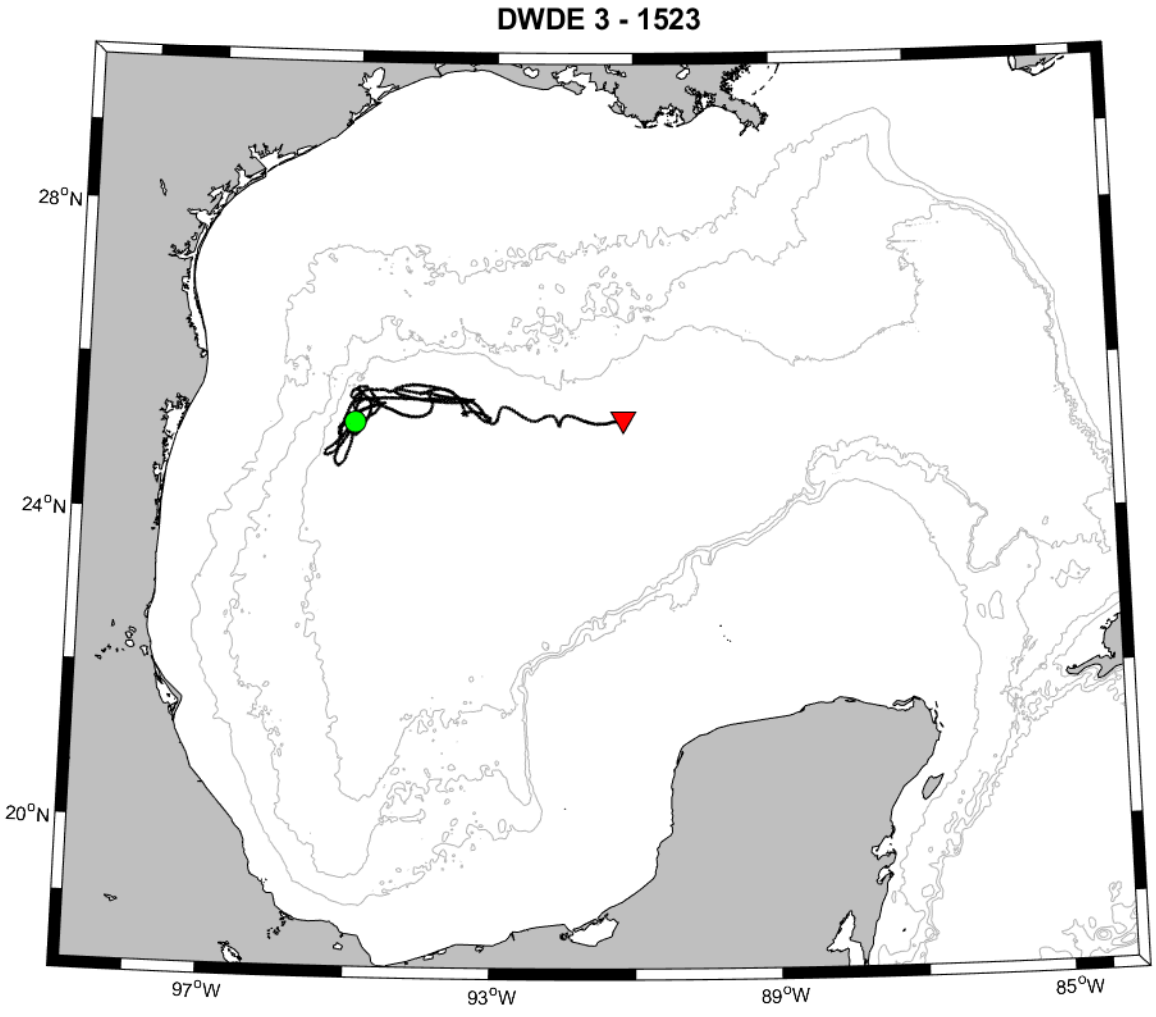

Float 1521 DWDE 3 (1500-dbar)
temperature (℃)
4.48
4.3
4.12
pressure (db)
1374
1474
1574
u-velocity (cm/s)
20
0
-20
v-velocity (cm/s)
20
0
-20
u-v velocity (cm/s)
20
0
-20
May 2017
Jul 2017
Sep 2017
Nov 2017
Jan 2018
Mar 2018
May 2018
Jul 2018
Sep 2018

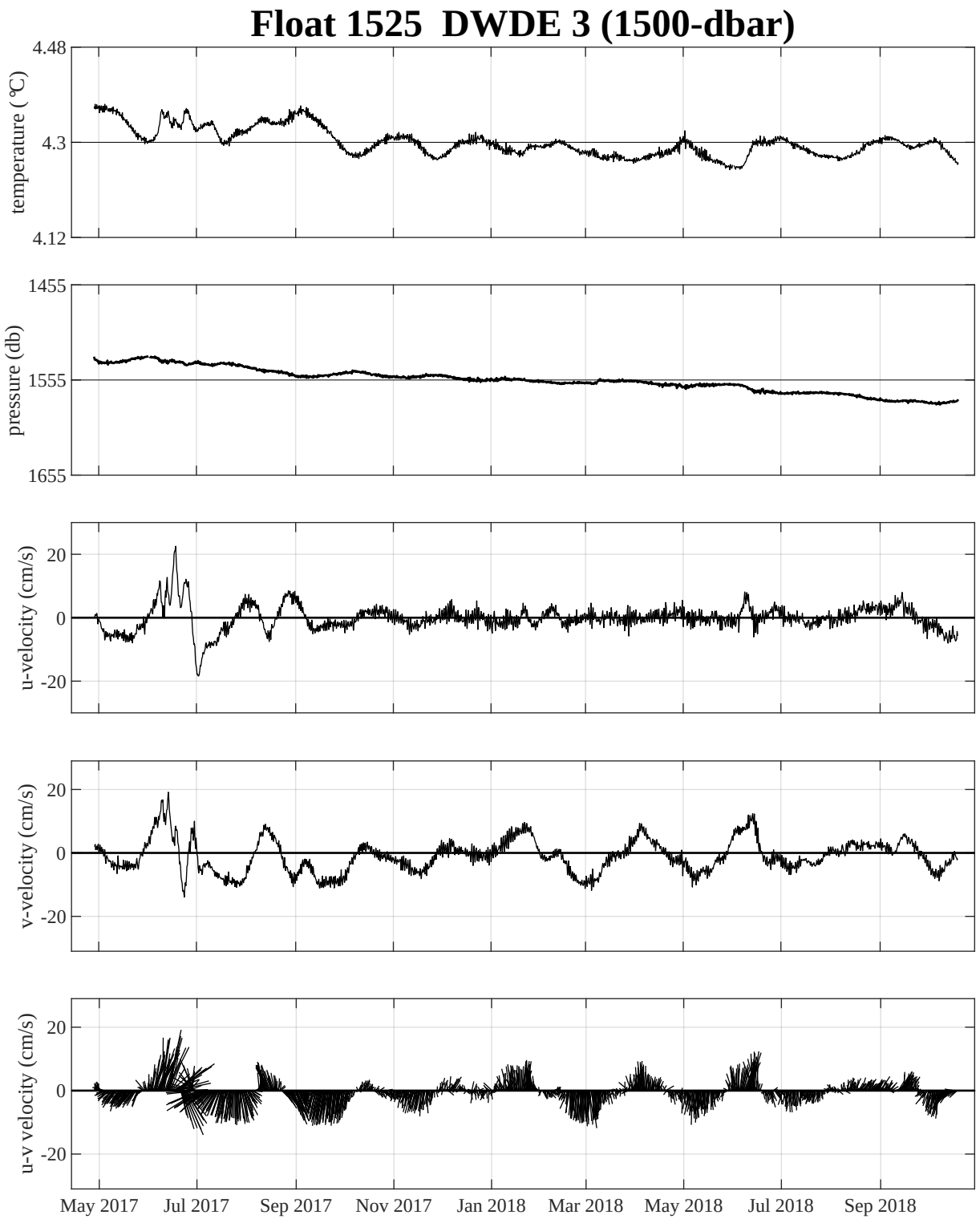

DWDE 3 - 1521
28°N
24°N
20°N
97°W
93°W
89°W
85°W

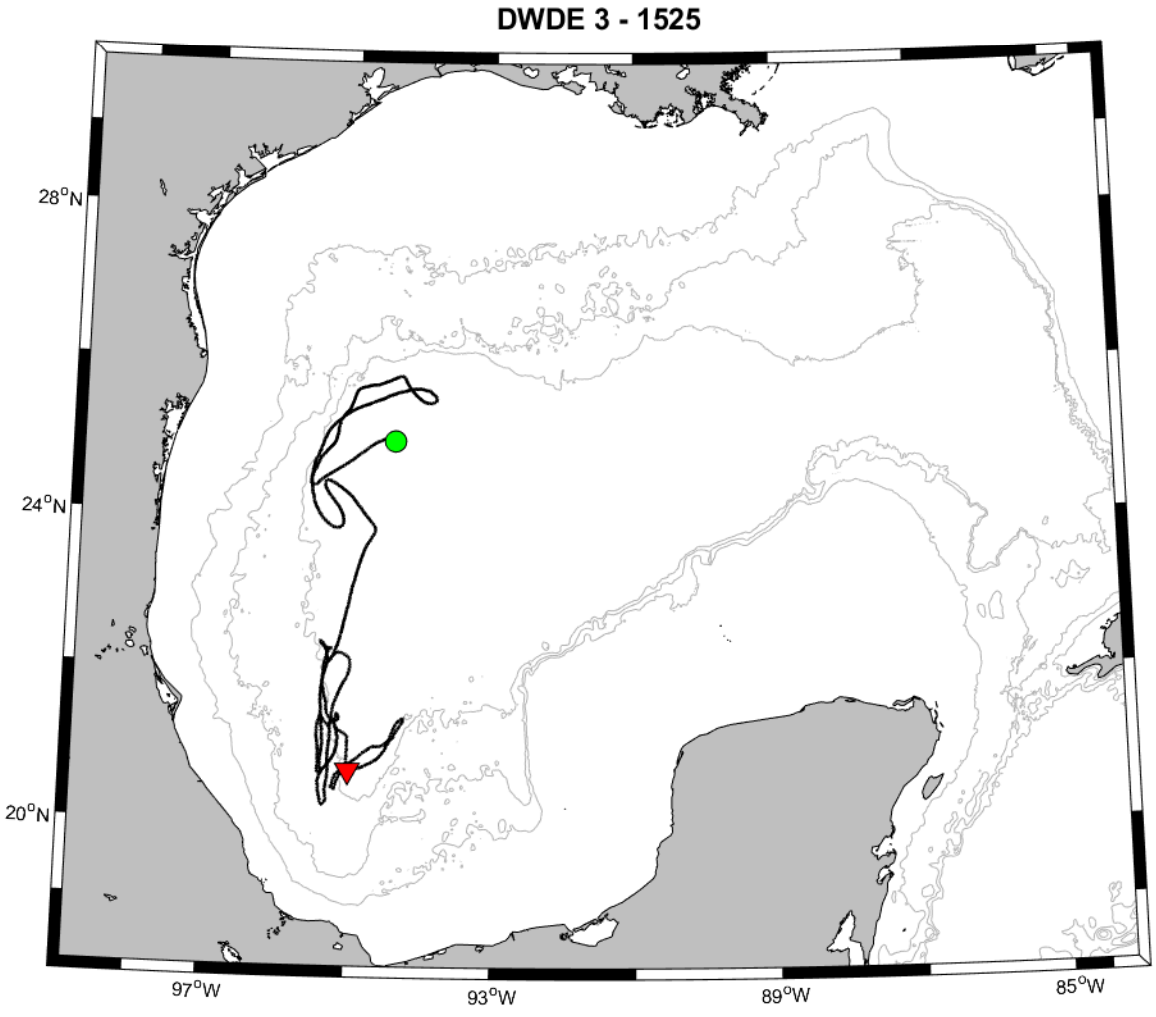

Float 1522 DWDE 3 (1500-dbar)
temperature (℃)
4.48
4.3
4.12
pressure (db)
1420
1520
1620
u-velocity (cm/s)
20
0
-20
v-velocity (cm/s)
20
0
-20
u-v velocity (cm/s)
20
0
-20
May 2017
Jul 2017
Sep 2017
Nov 2017
Jan 2018
Mar 2018
May 2018
Jul 2018
Sep 2018

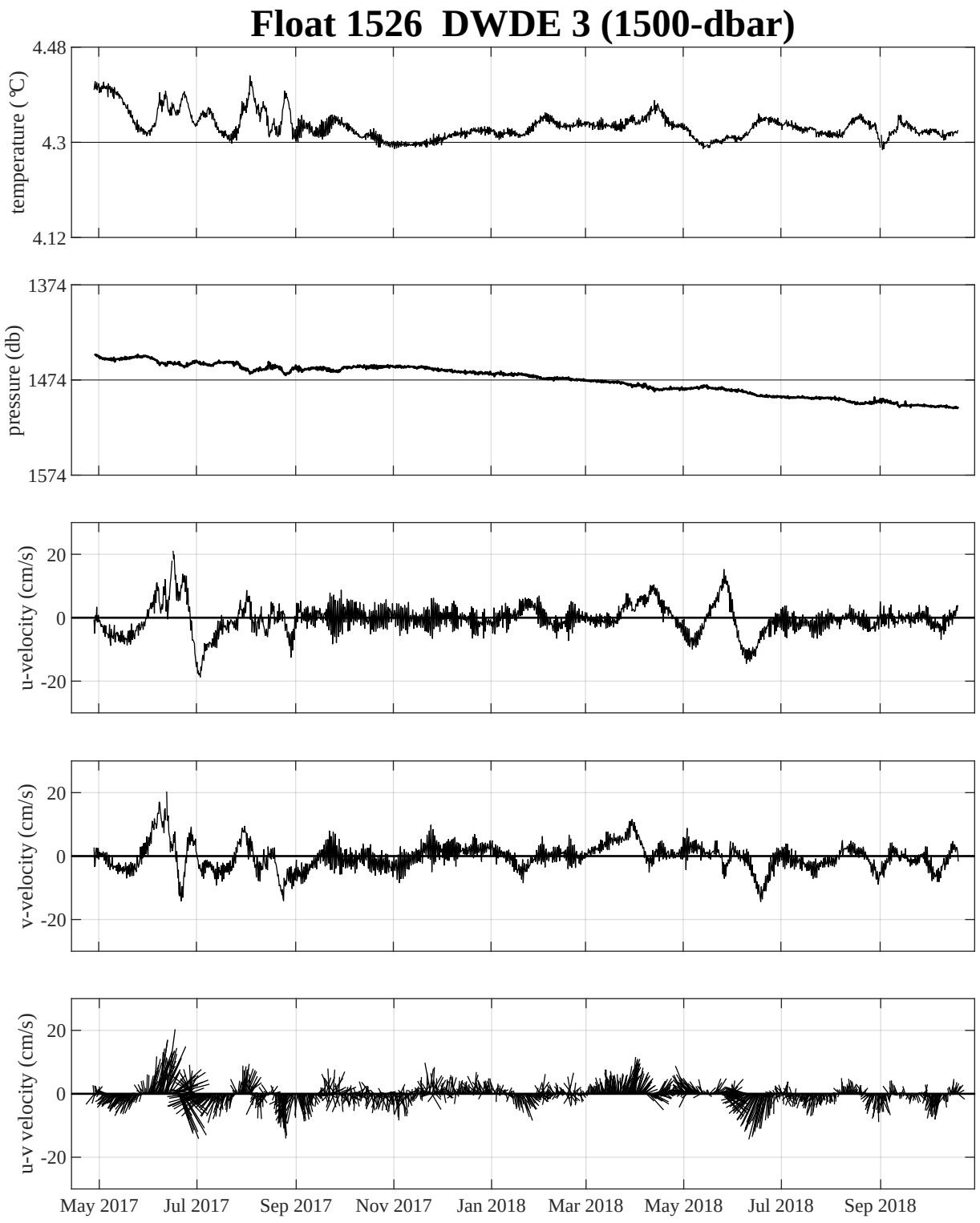

DWDE 3 - 1522
28°N
24°N
20°N
97°W
93°W
89°W
85°W

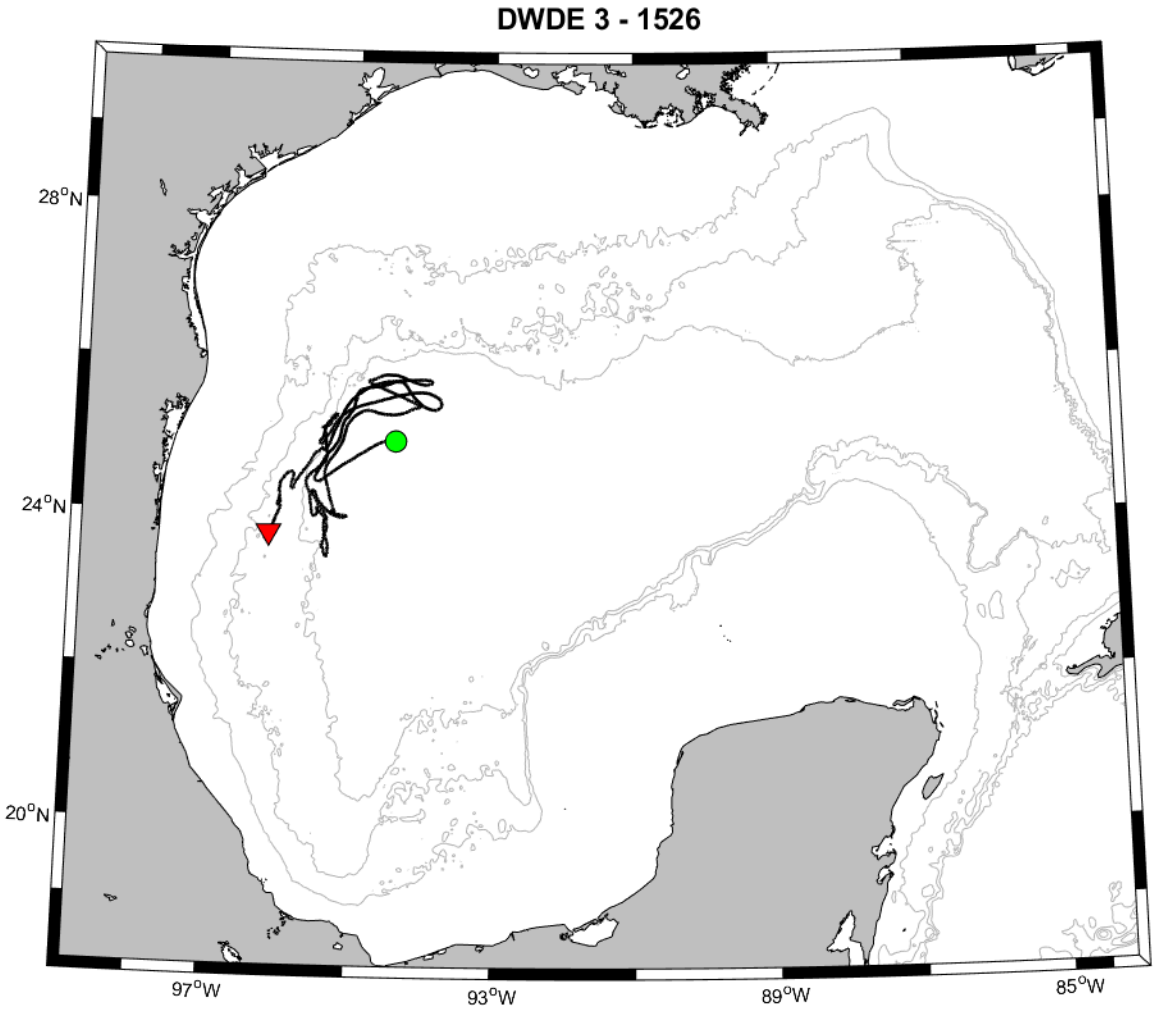

Float 1523 DWDE 3 (1500-dbar)
temperature (℃)
4.48
4.3
4.12
pressure (db)
1379
1479
1579
u-velocity (cm/s)
20
0
-20
v-velocity (cm/s)
20
0
-20
u-v velocity (cm/s)
20
0
-20
May 2017
Jul 2017
Sep 2017
Nov 2017
Jan 2018
Mar 2018
May 2018
Jul 2018
Sep 2018

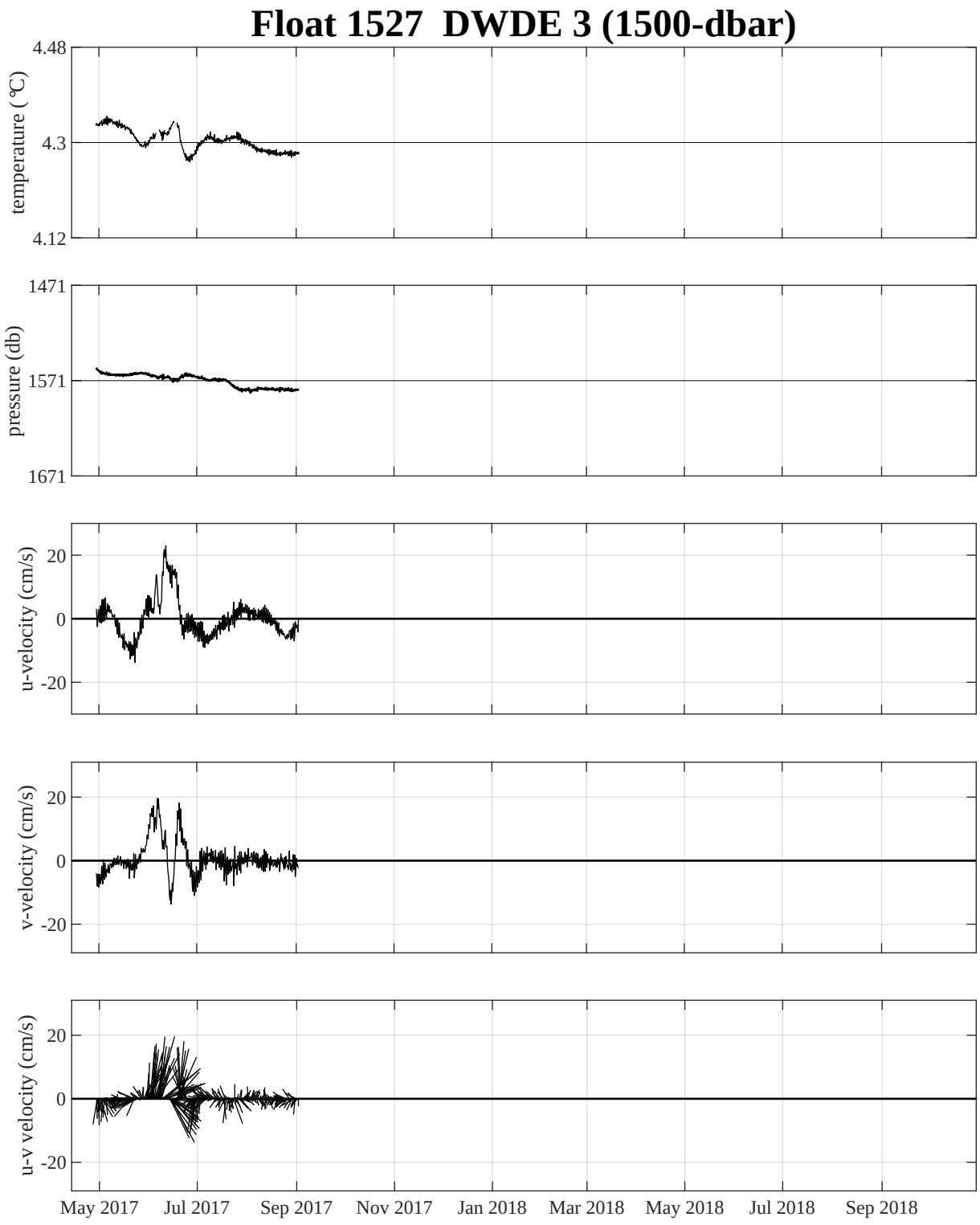

DWDE 3 - 1523
28°N
24°N
20°N
97°W
93°W
89°W
85°W

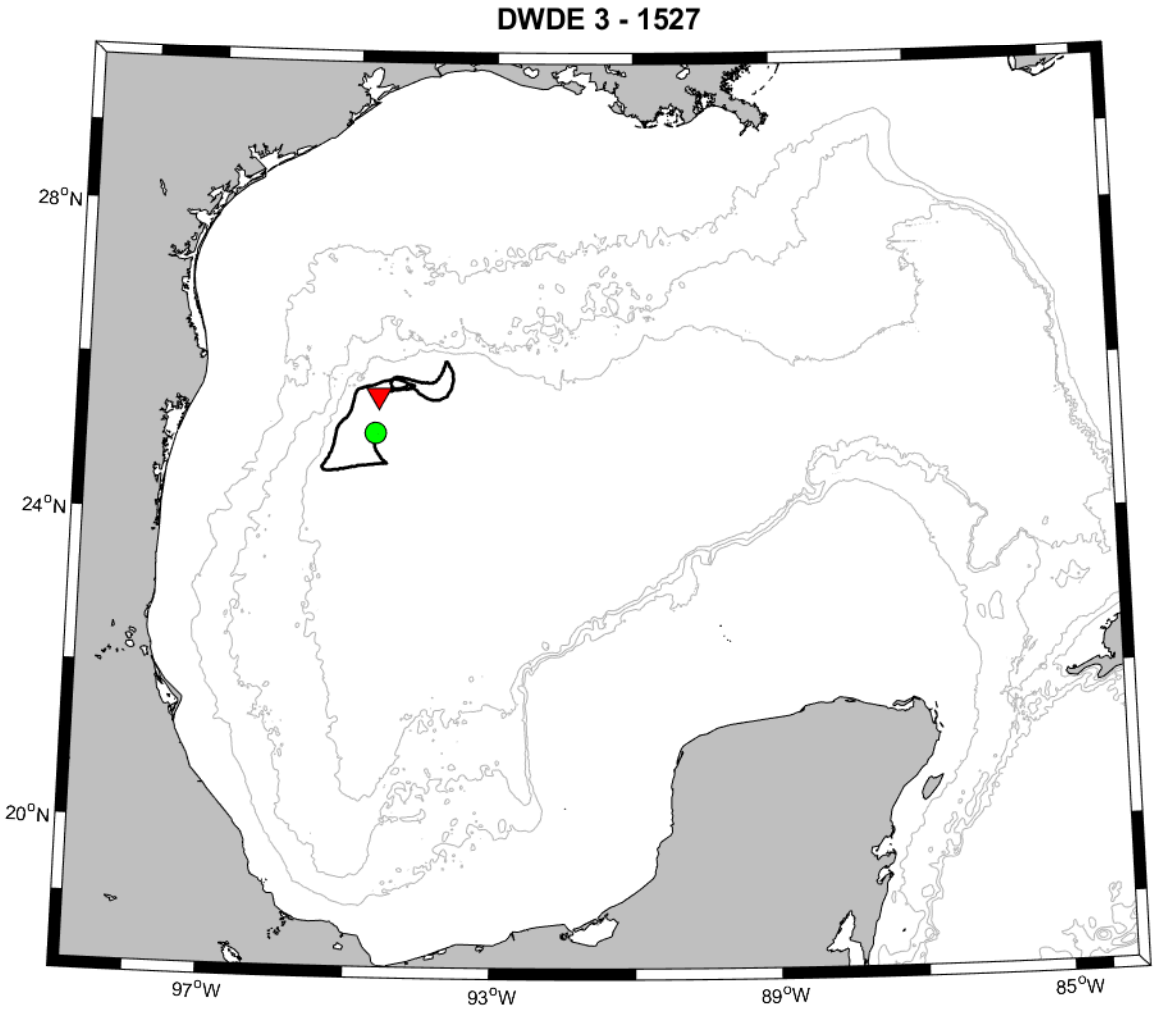

Float 1525 DWDE 3 (1500-dbar)
temperature (℃)
4.48
4.3
4.12
pressure (db)
1455
1555
1655
u-velocity (cm/s)
20
0
-20
v-velocity (cm/s)
20
0
-20
u-v velocity (cm/s)
20
0
-20
May 2017
Jul 2017
Sep 2017
Nov 2017
Jan 2018
Mar 2018
May 2018
Jul 2018
Sep 2018

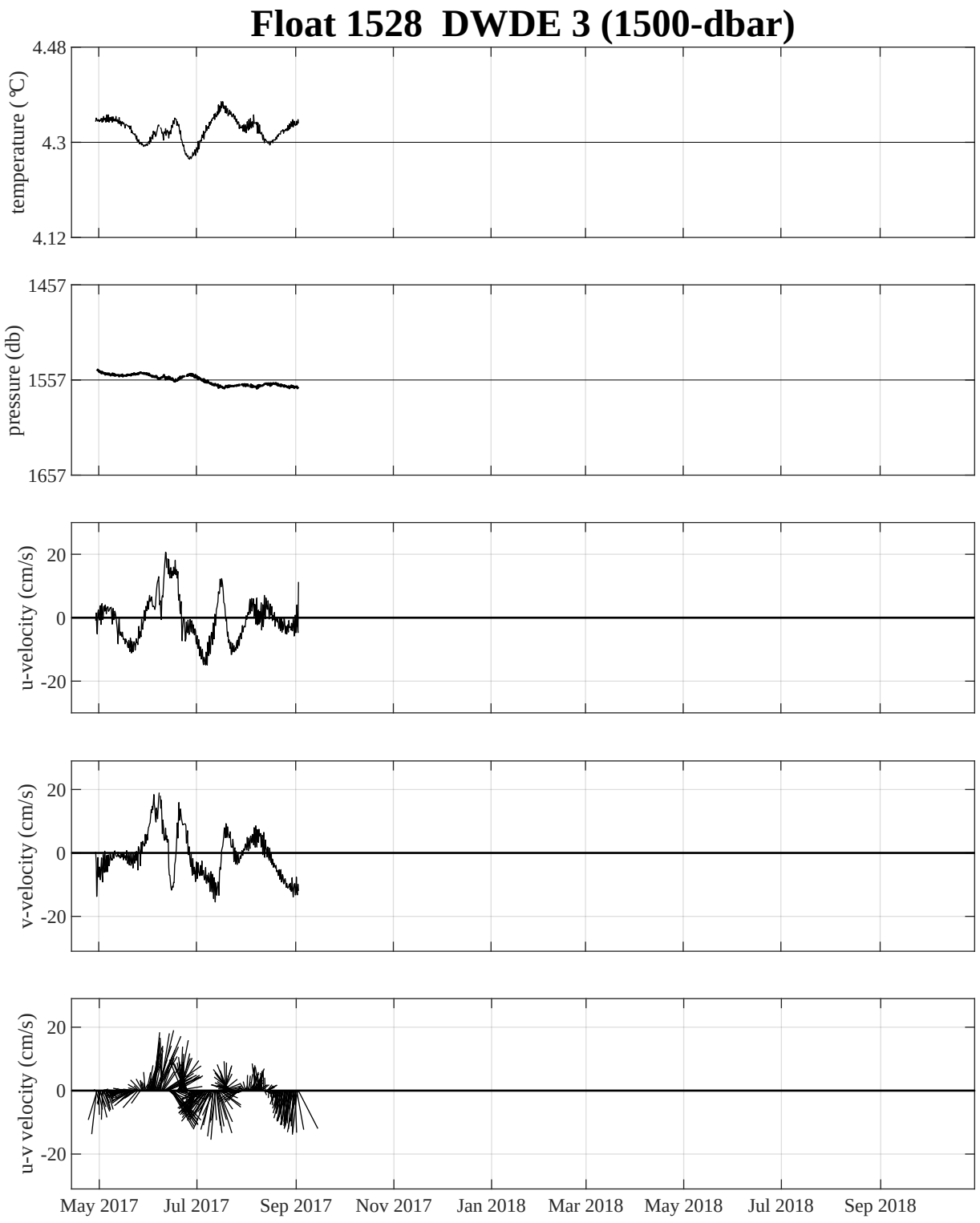

DWDE 3 - 1525
28°N
24°N
20°N
97°W
93°W
89°W
85°W

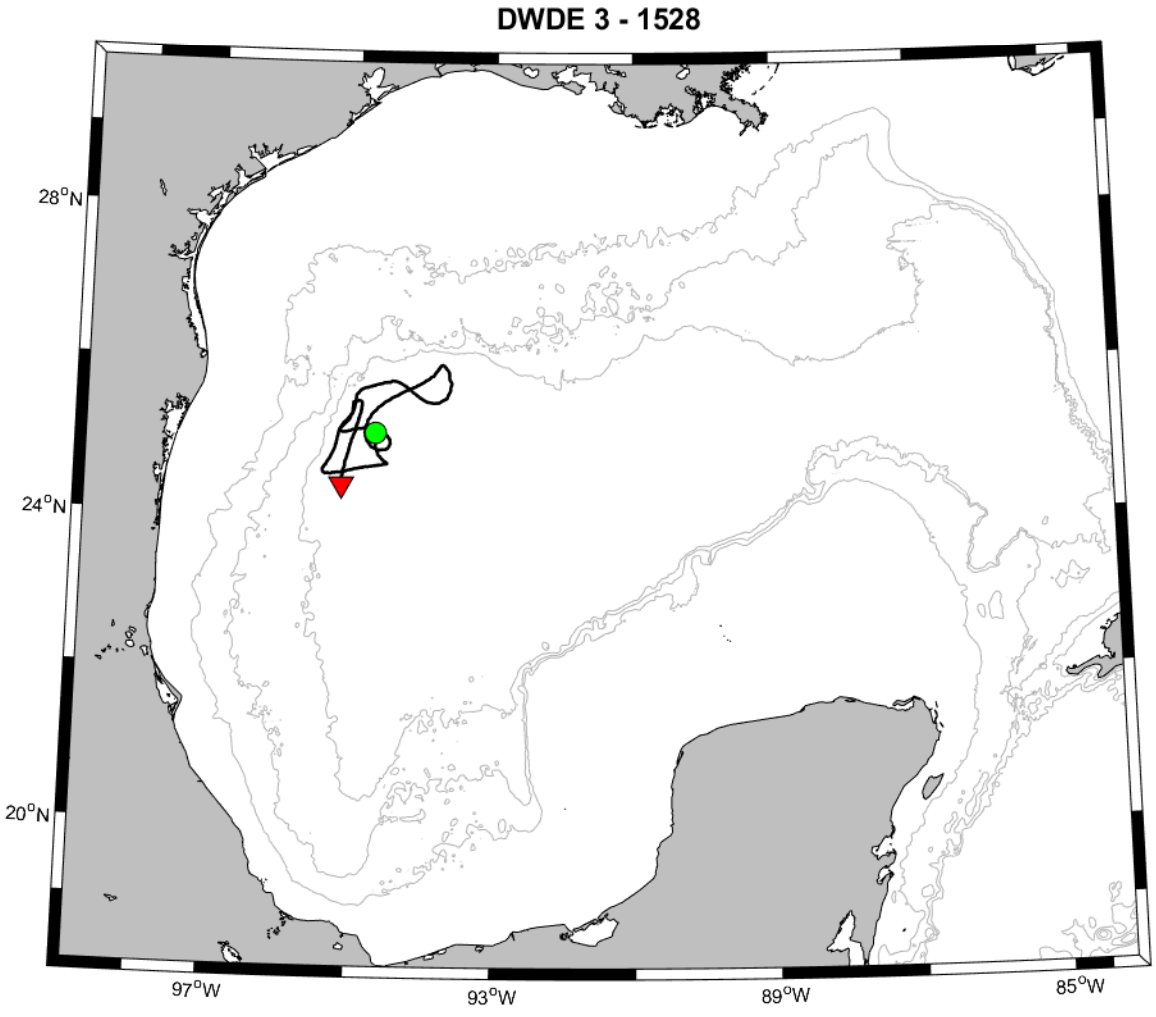

Float 1526 DWDE 3 (1500-dbar)
temperature (℃)
4.48
4.3
4.12
pressure (db)
1374
1474
1574
u-velocity (cm/s)
20
0
-20
v-velocity (cm/s)
20
0
-20
u-v velocity (cm/s)
20
0
-20
May 2017
Jul 2017
Sep 2017
Nov 2017
Jan 2018
Mar 2018
May 2018
Jul 2018
Sep 2018

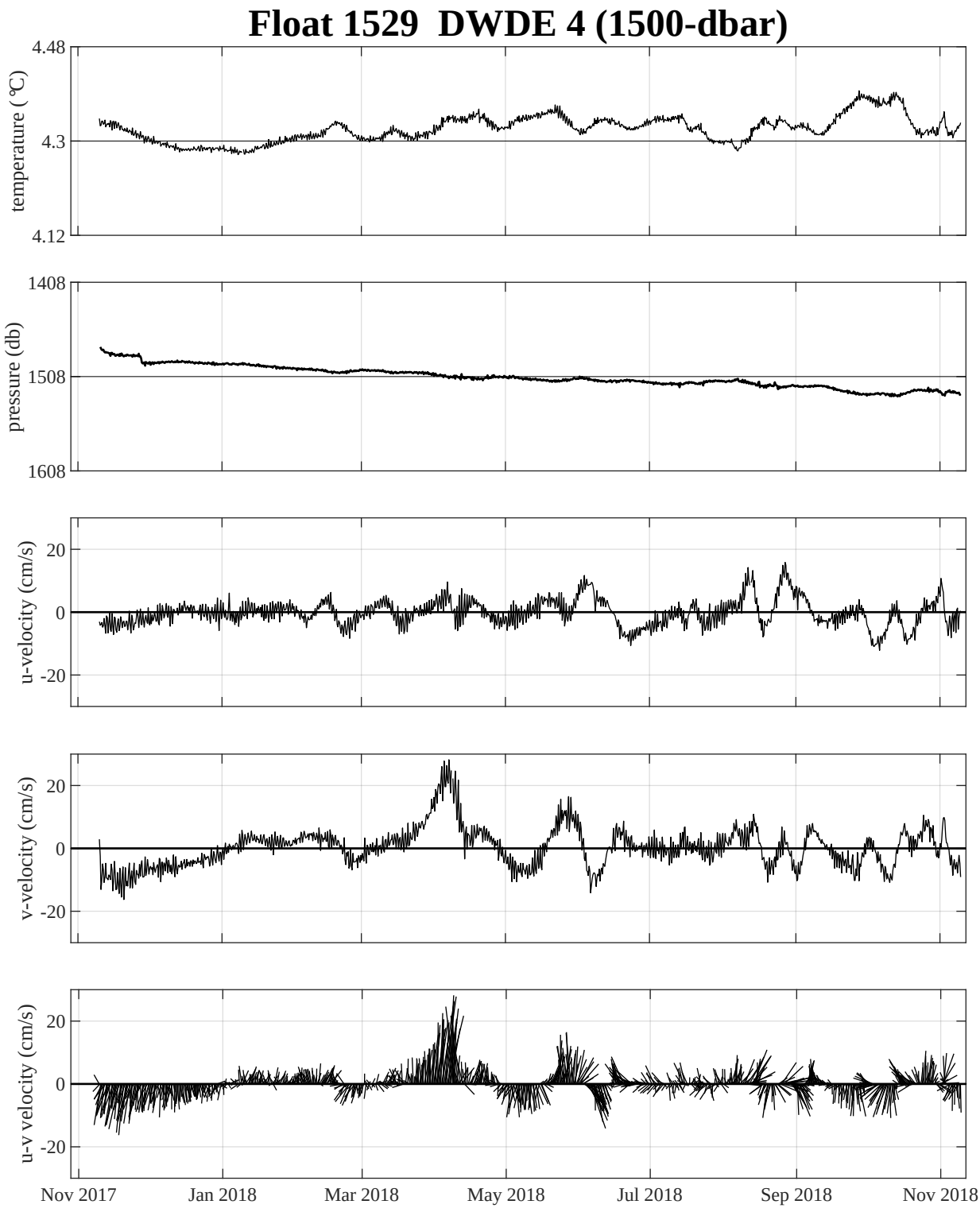

DWDE 3 - 1526
28°N
24°N
20°N
97°W
93°W
89°W
85°W

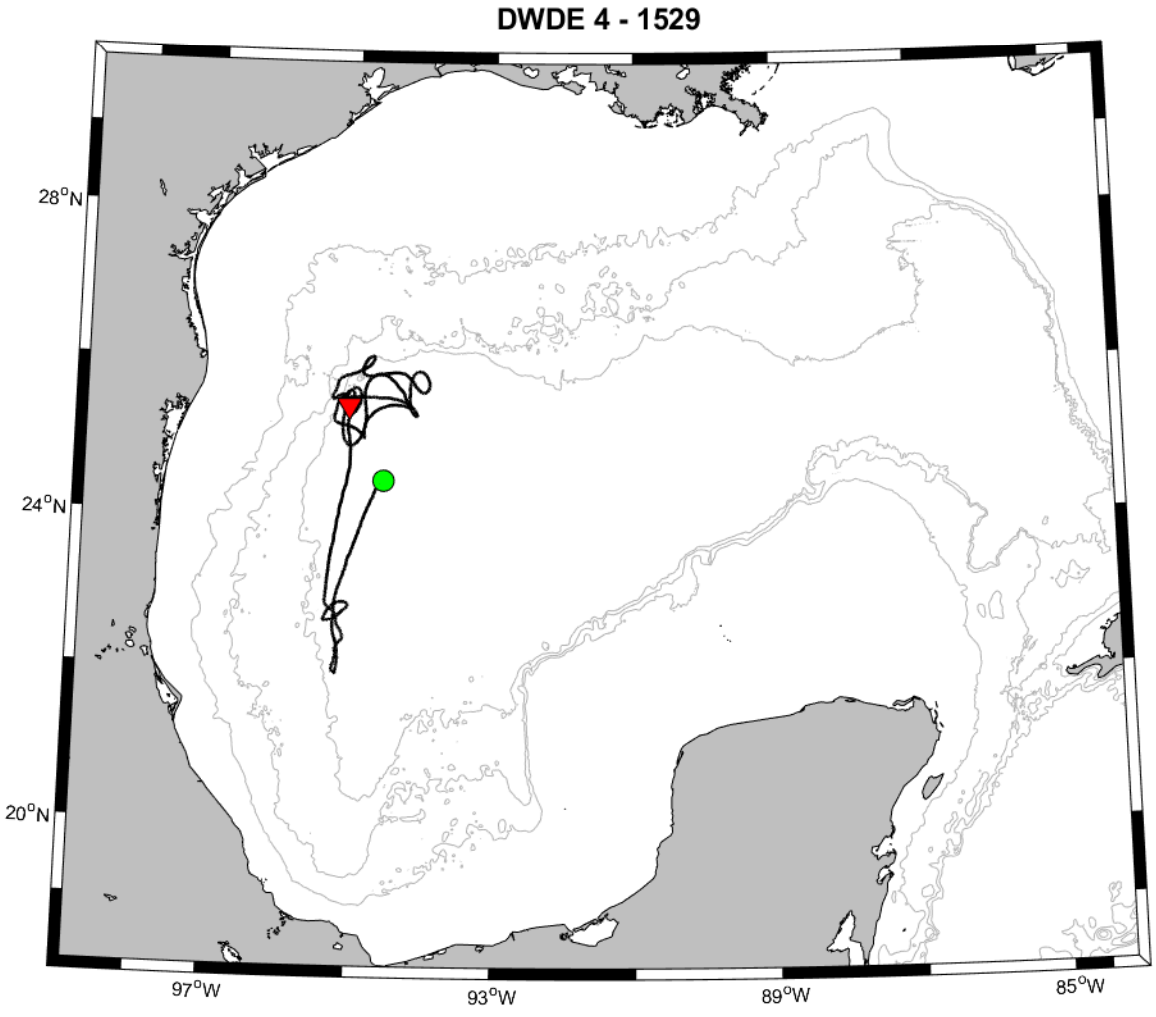

Float 1527 DWDE 3 (1500-dbar)
temperature (℃)
4.48
4.3
4.12
pressure (db)
1471
1571
1671
u-velocity (cm/s)
20
0
-20
v-velocity (cm/s)
20
0
-20
u-v velocity (cm/s)
20
0
-20
May 2017
Jul 2017
Sep 2017
Nov 2017
Jan 2018
Mar 2018
May 2018
Jul 2018
Sep 2018

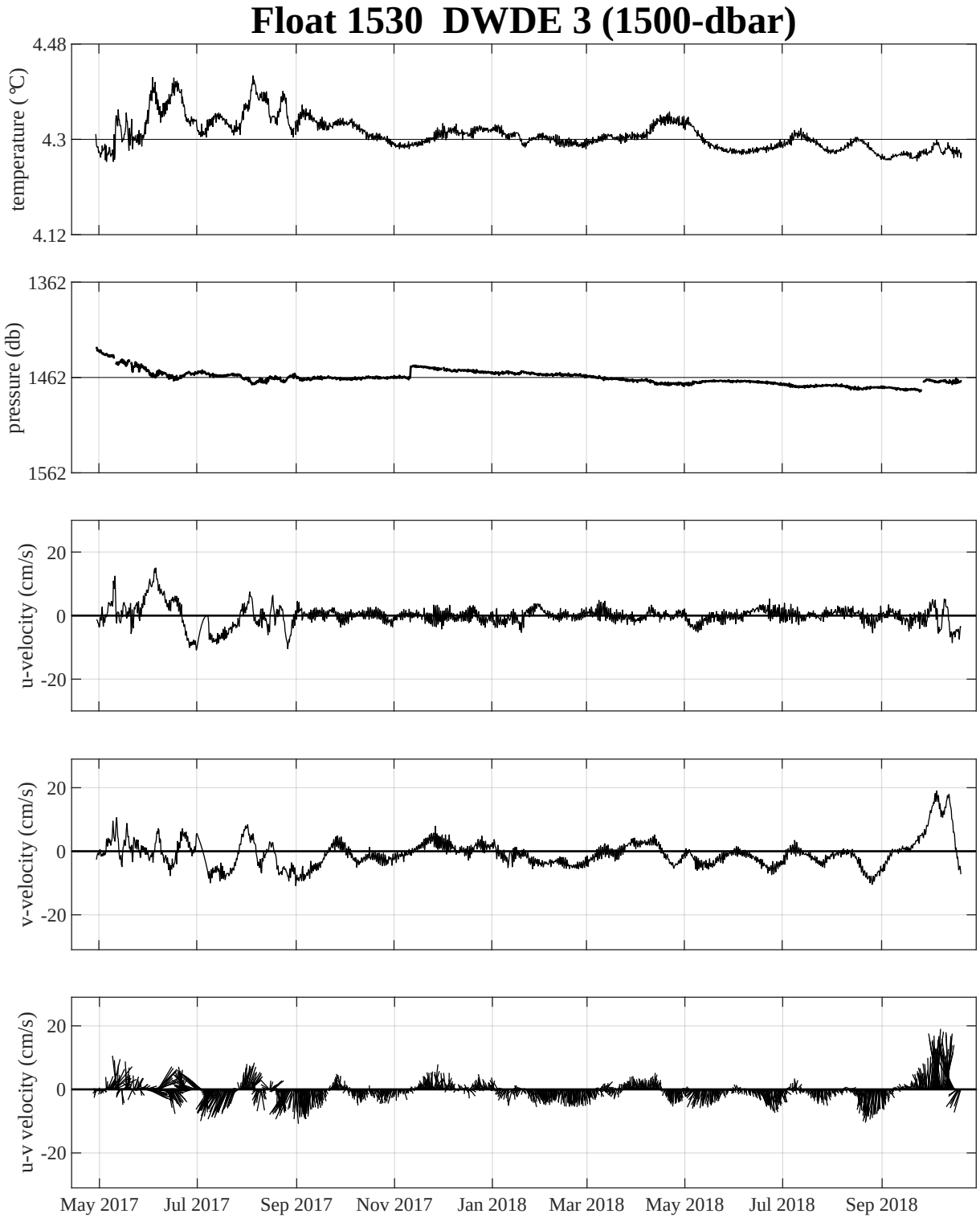

DWDE 3 - 1527
28°N
24°N
20°N
97°W
93°W
89°W
85°W

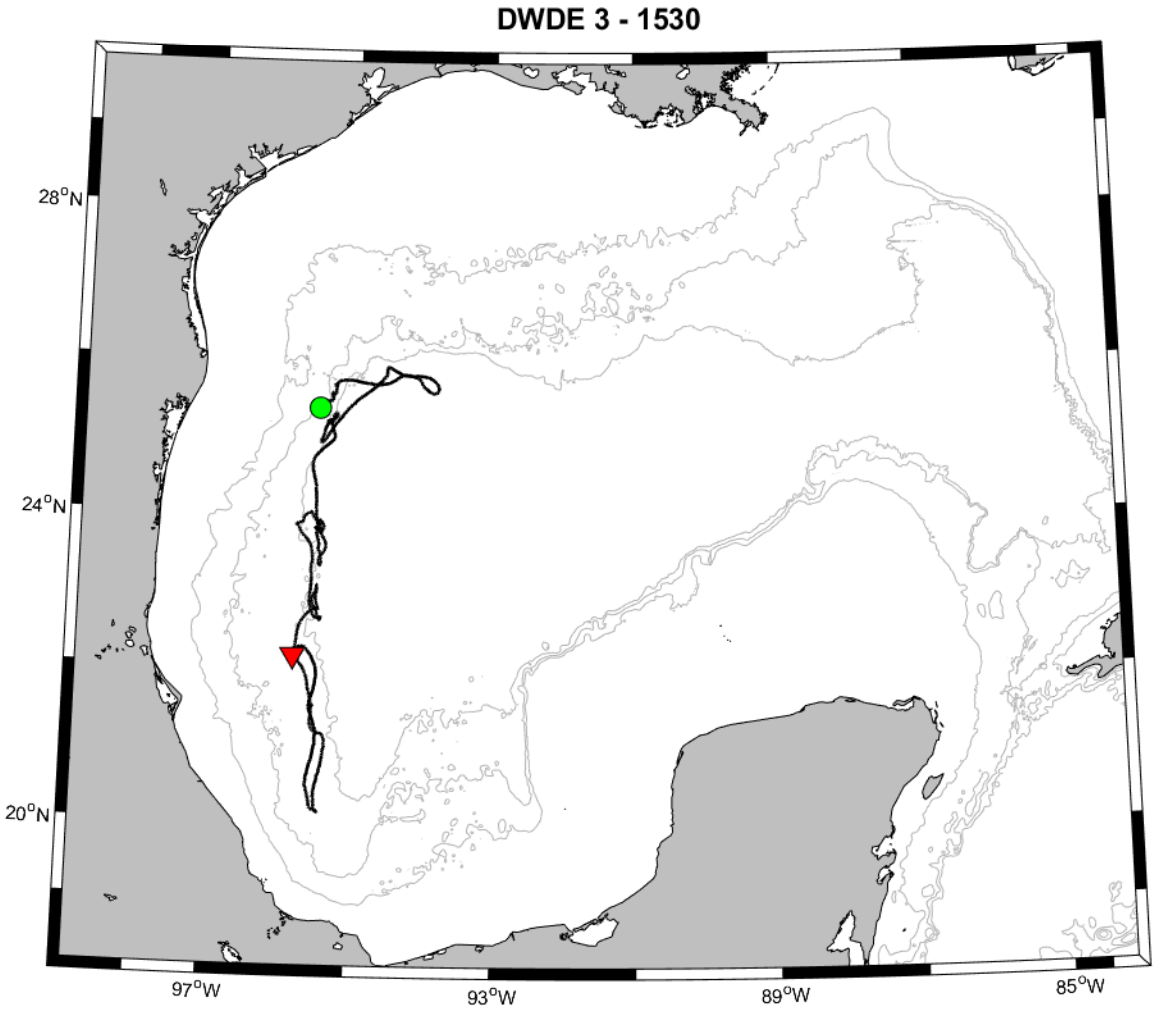

Float 1528 DWDE 3 (1500-dbar)
temperature (℃)
4.48
4.3
4.12
pressure (db)
1457
1557
1657
u-velocity (cm/s)
20
0
-20
v-velocity (cm/s)
20
0
-20
u-v velocity (cm/s)
20
0
-20
May 2017
Jul 2017
Sep 2017
Nov 2017
Jan 2018
Mar 2018
May 2018
Jul 2018
Sep 2018

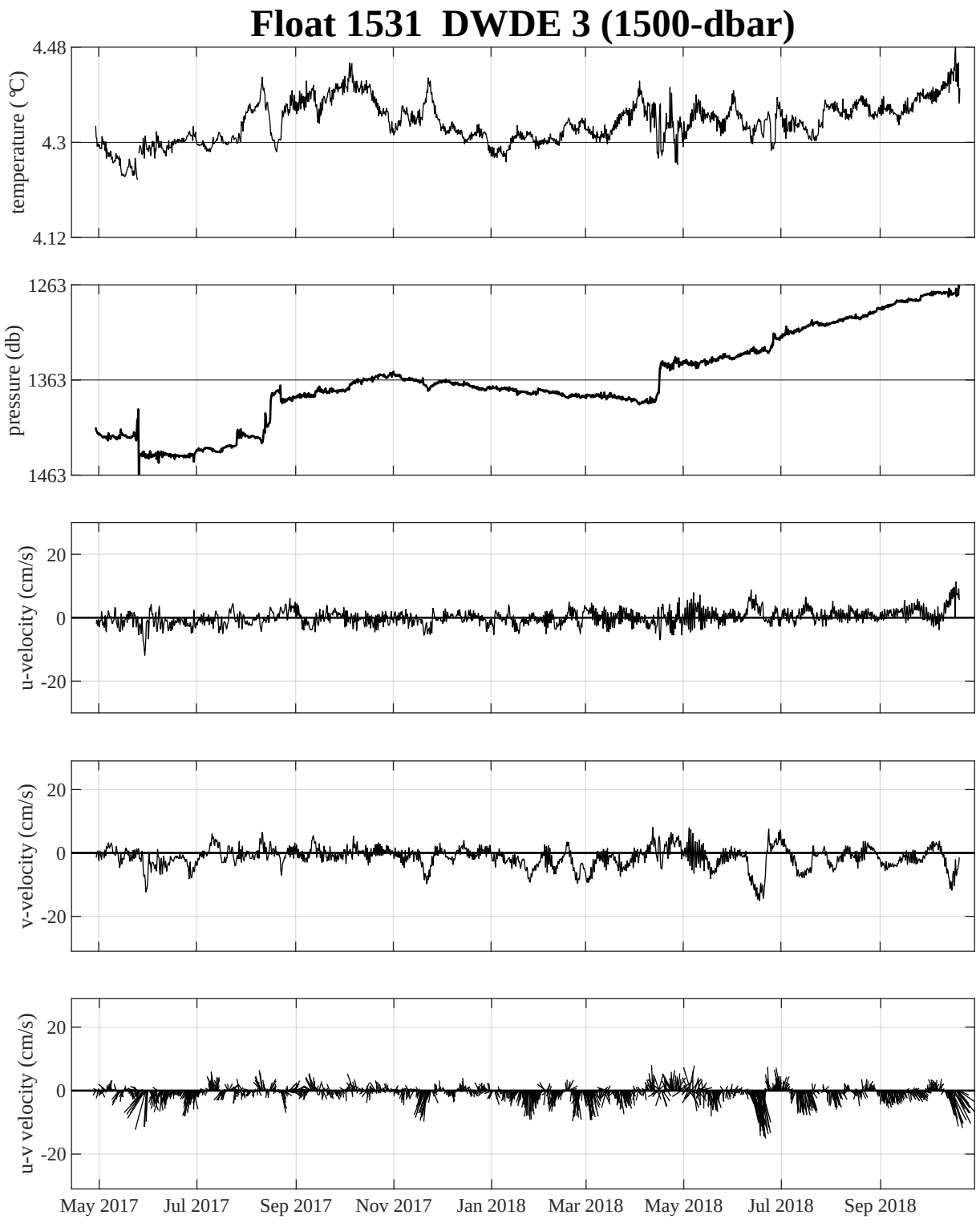

DWDE 3 - 1528
28°N
24°N
20°N
97°W
93°W
89°W
85°W

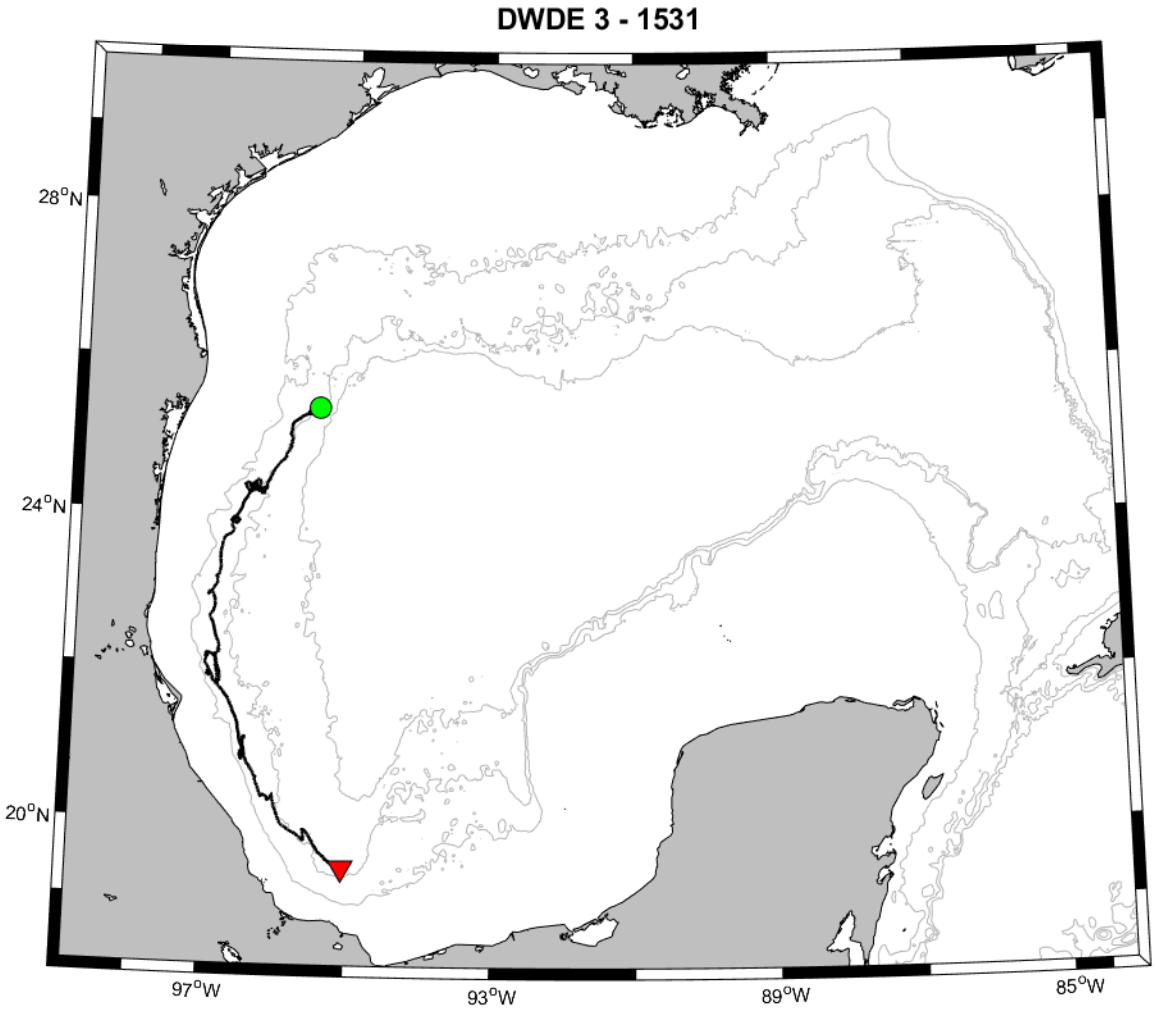

Float 1529 DWDE 4 (1500-dbar)
temperature (℃)
4.48
4.3
4.12
pressure (db)
1408
1508
1608
u-velocity (cm/s)
20
0
-20
v-velocity (cm/s)
20
0
-20
u-v velocity (cm/s)
20
0
-20
Nov 2017
Jan 2018
Mar 2018
May 2018
Jul 2018
Sep 2018
Nov 2018

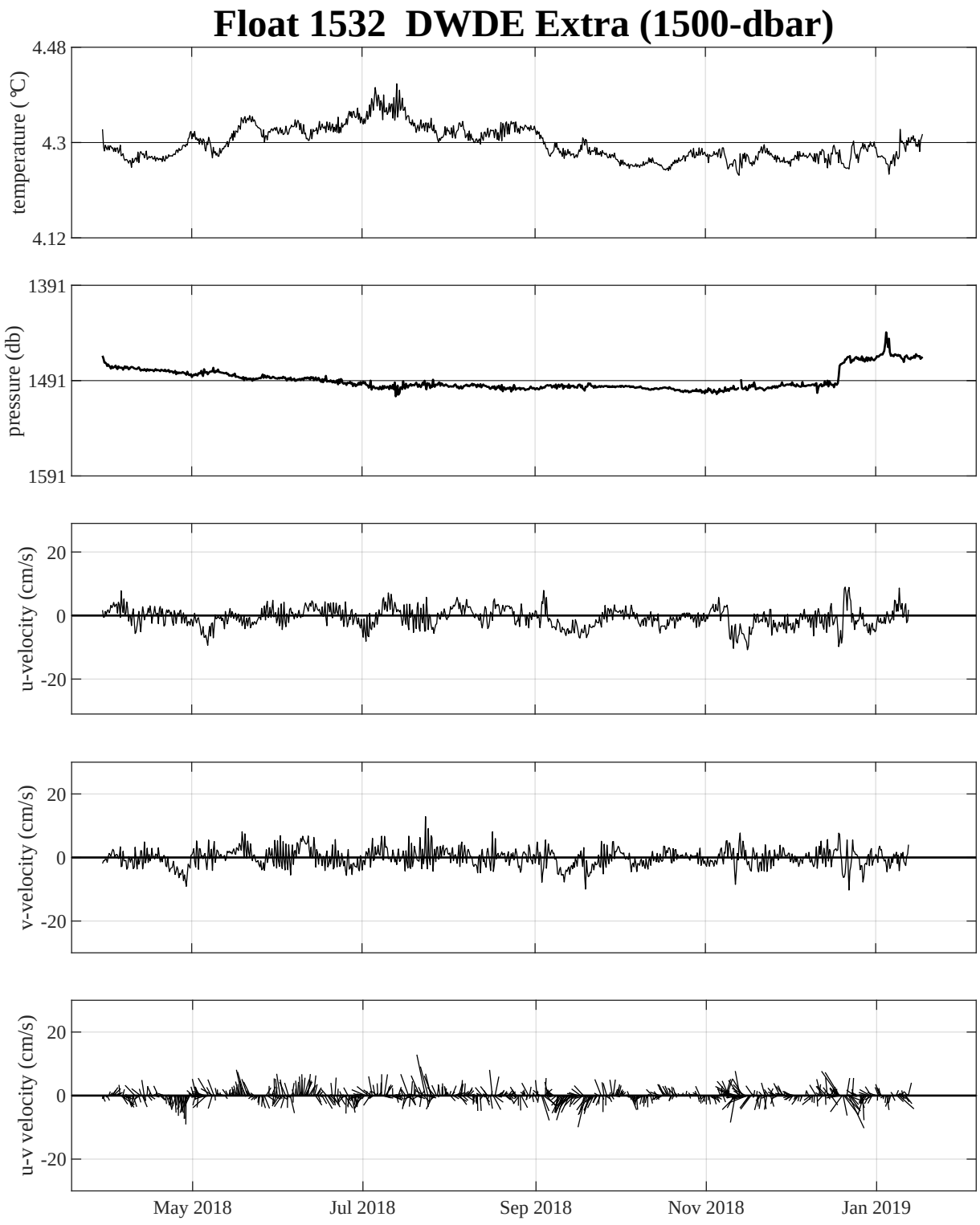

DWDE 4 - 1529
28°N
24°N
20°N
97°W
93°W
89°W
85°W

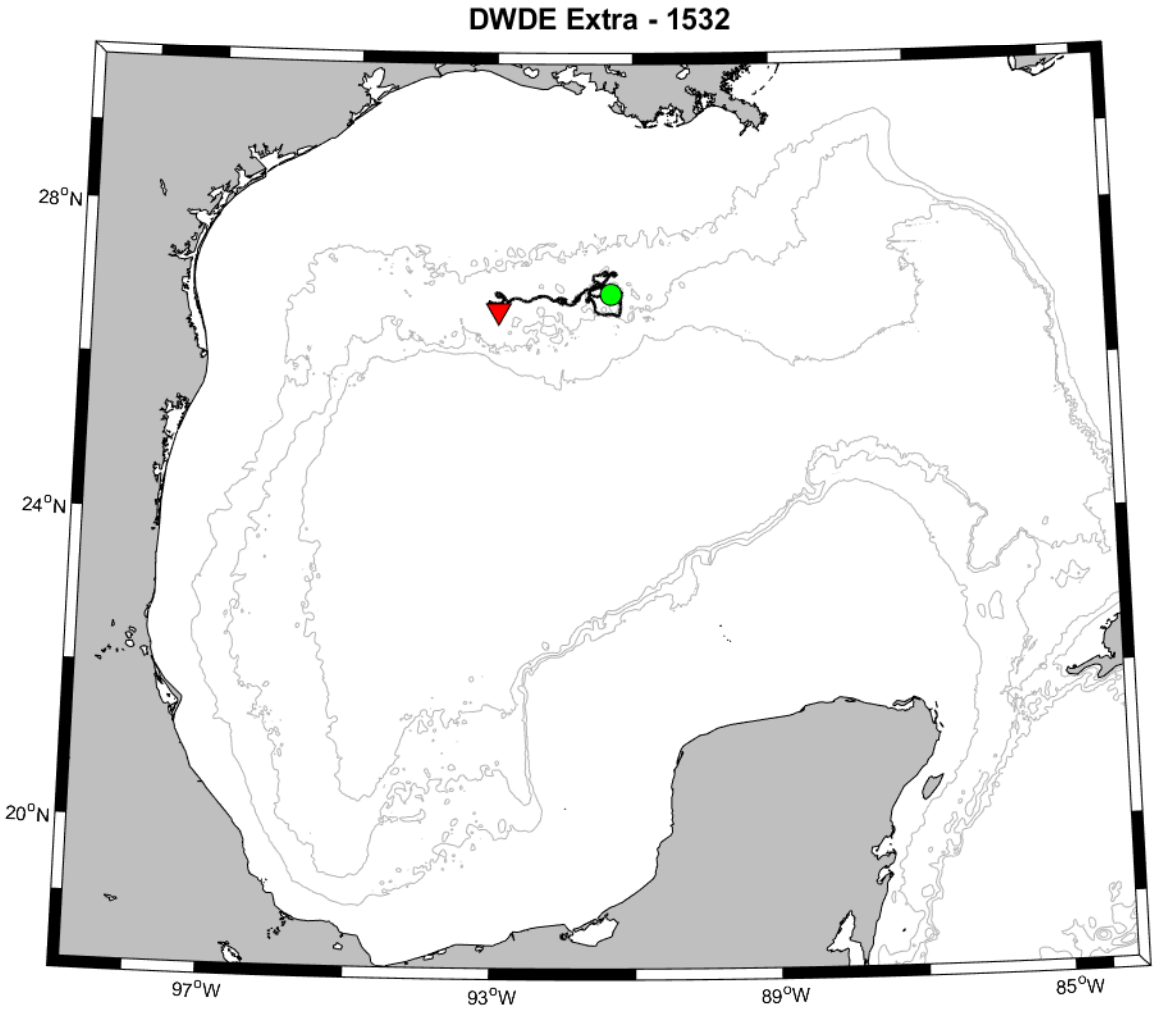

Float 1530 DWDE 3 (1500-dbar)
temperature (℃)
4.48
4.3
4.12
pressure (db)
1362
1462
1562
u-velocity (cm/s)
20
0
-20
v-velocity (cm/s)
20
0
-20
u-v velocity (cm/s)
20
0
-20
May 2017
Jul 2017
Sep 2017
Nov 2017
Jan 2018
Mar 2018
May 2018
Jul 2018
Sep 2018


DWDE 3 - 1530
28°N
24°N
20°N
97°W
93°W
89°W
85°W

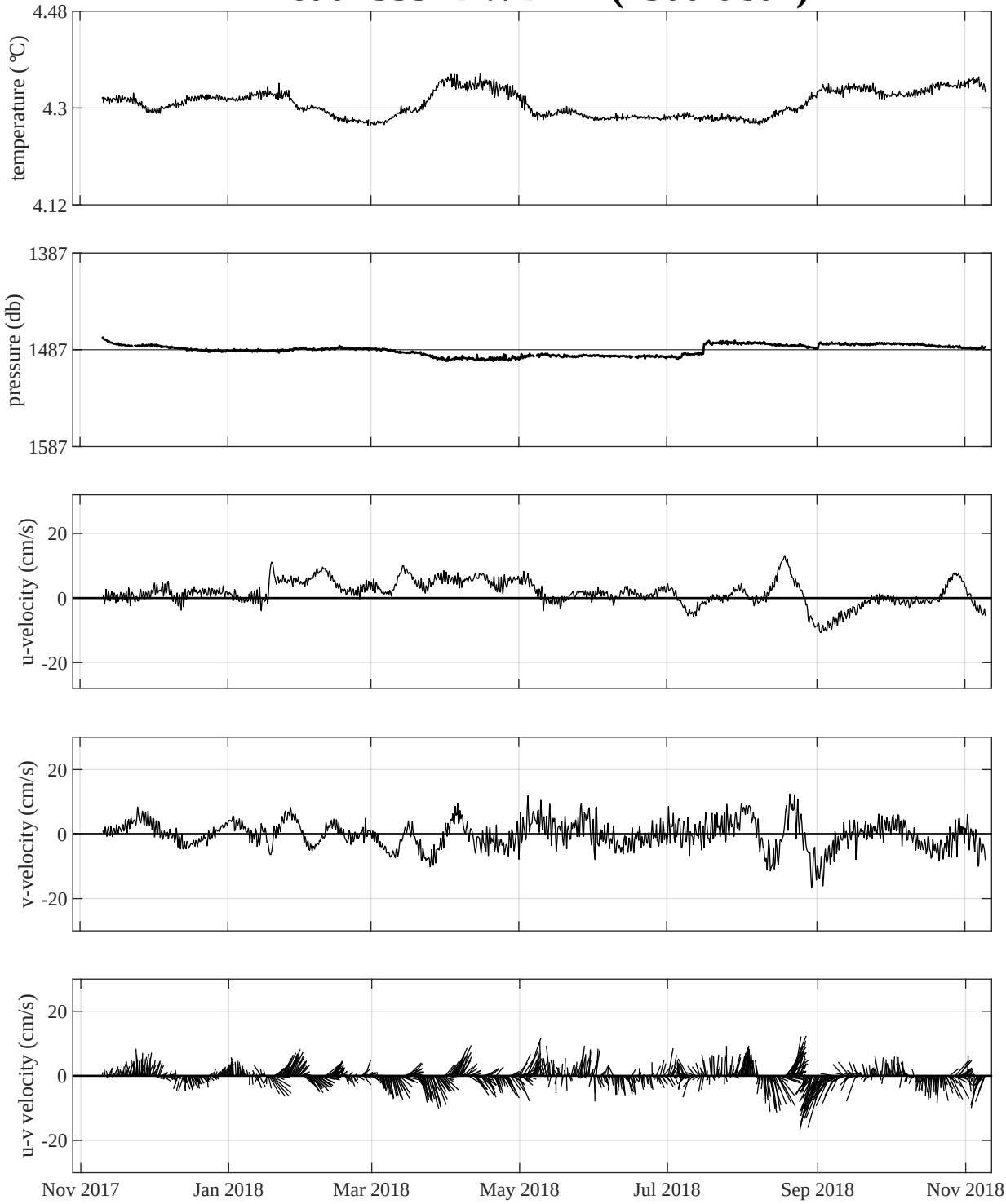

Float 1531 DWDE 3 (1500-dbar)
temperature (℃)
4.48
4.3
4.12
pressure (db)
1263
1363
1463
u-velocity (cm/s)
20
0
-20
v-velocity (cm/s)
20
0
-20
u-v velocity (cm/s)
20
0
-20
May 2017
Jul 2017
Sep 2017
Nov 2017
Jan 2018
Mar 2018
May 2018
Jul 2018
Sep 2018

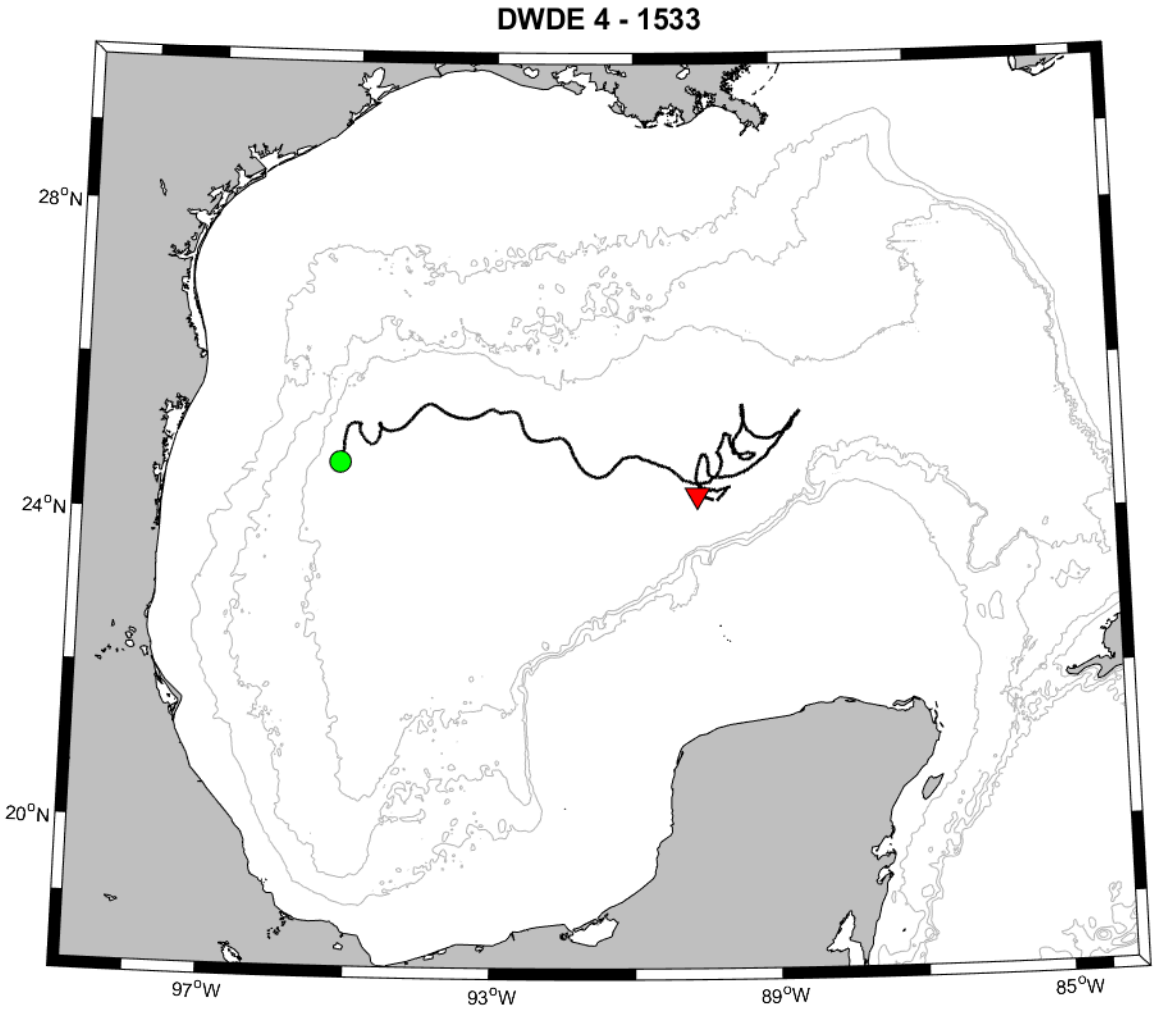

DWDE 3 - 1531
28°N
24°N
20°N
97°W
93°W
89°W
85°W

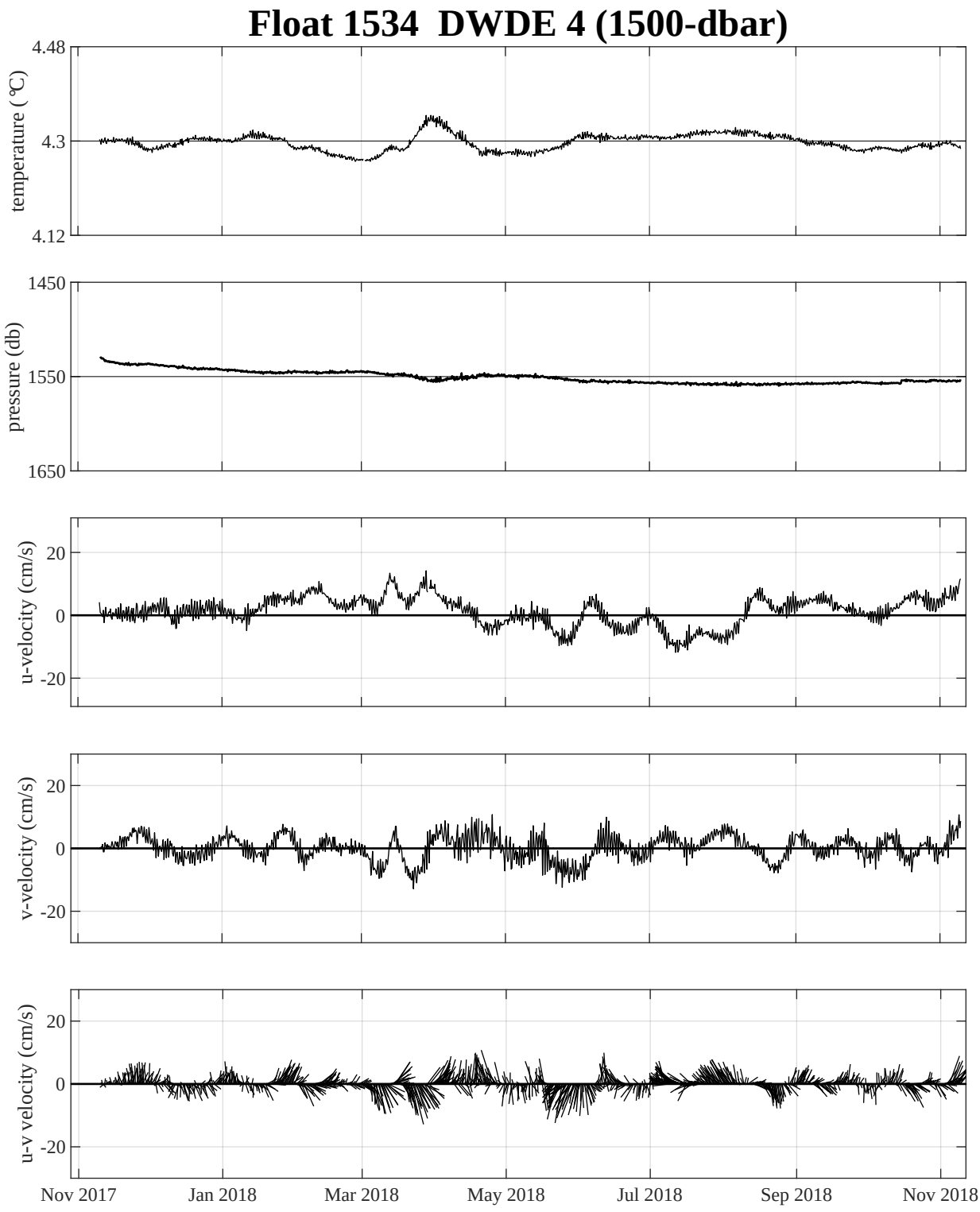

Float 1532 DWDE Extra (1500-dbar)
temperature (℃)
4.48
4.3
4.12
pressure (db)
1391
1491
1591
u-velocity (cm/s)
20
0
-20
v-velocity (cm/s)
20
0
-20
u-v velocity (cm/s)
20
0
-20
May 2018
Jul 2018
Sep 2018
Nov 2018
Jan 2019

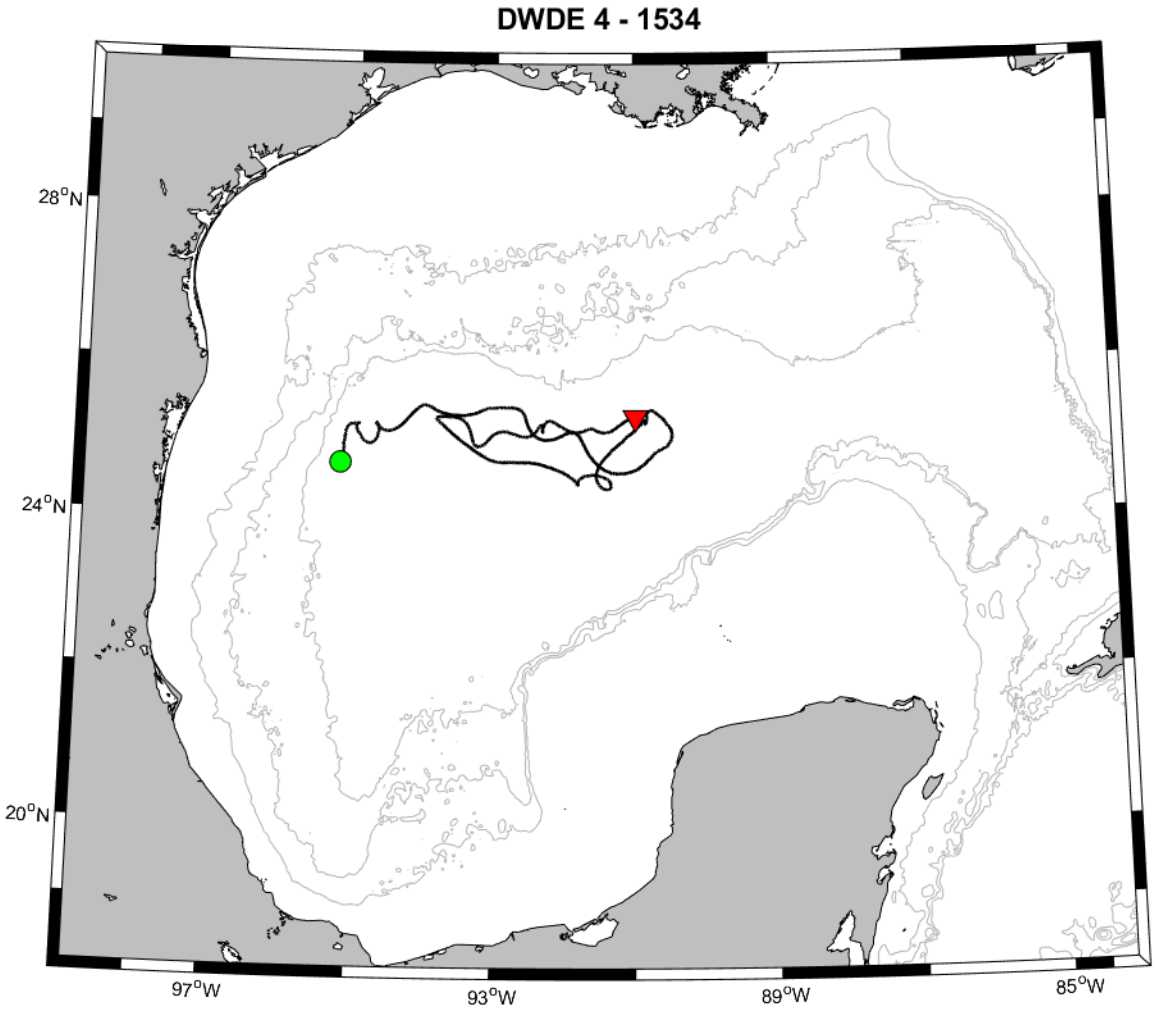

DWDE Extra - 1532
28°N
24°N
20°N
97°W
93°W
89°W
85°W

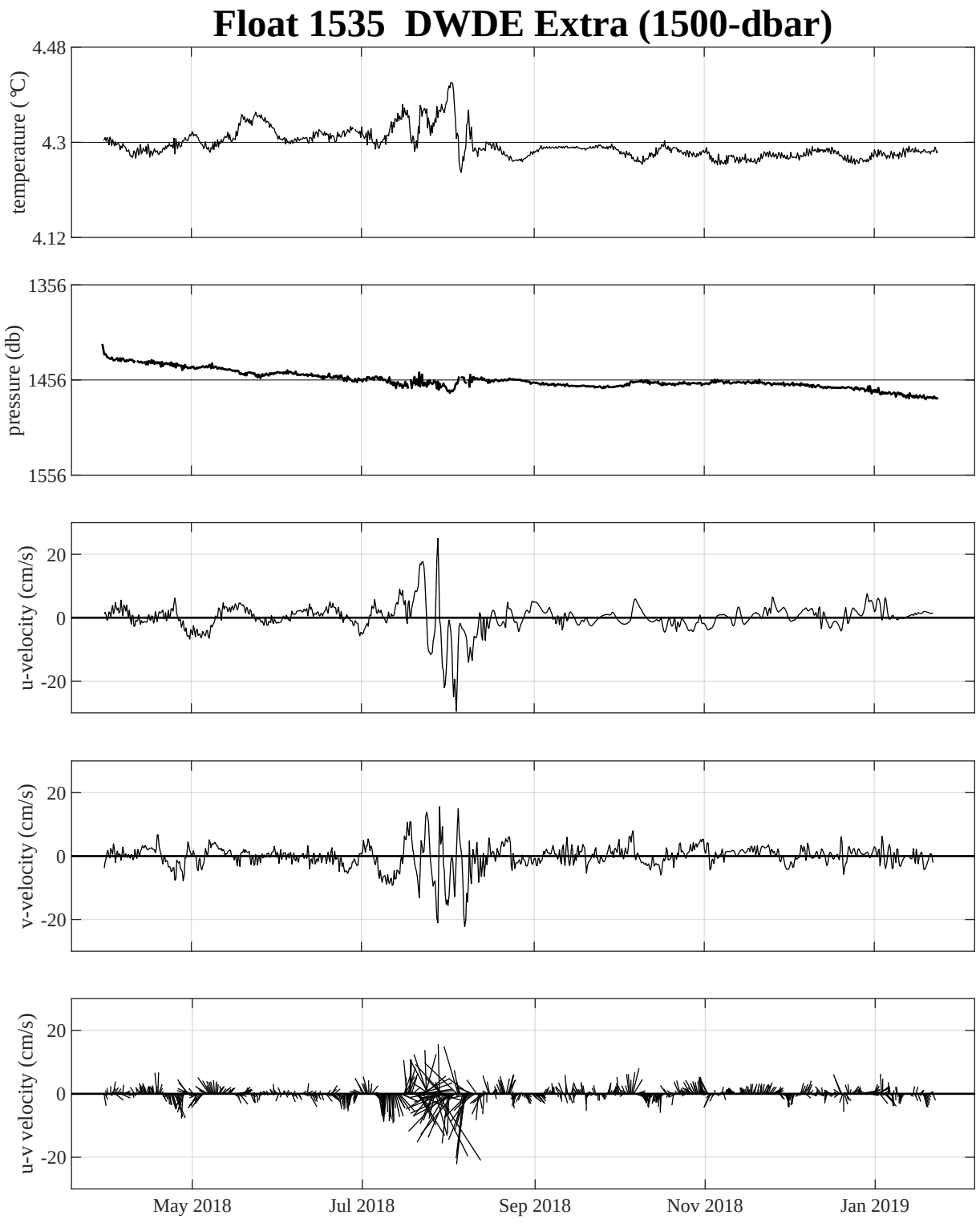
Float 1533 DWDE 4 (1500-dbar)

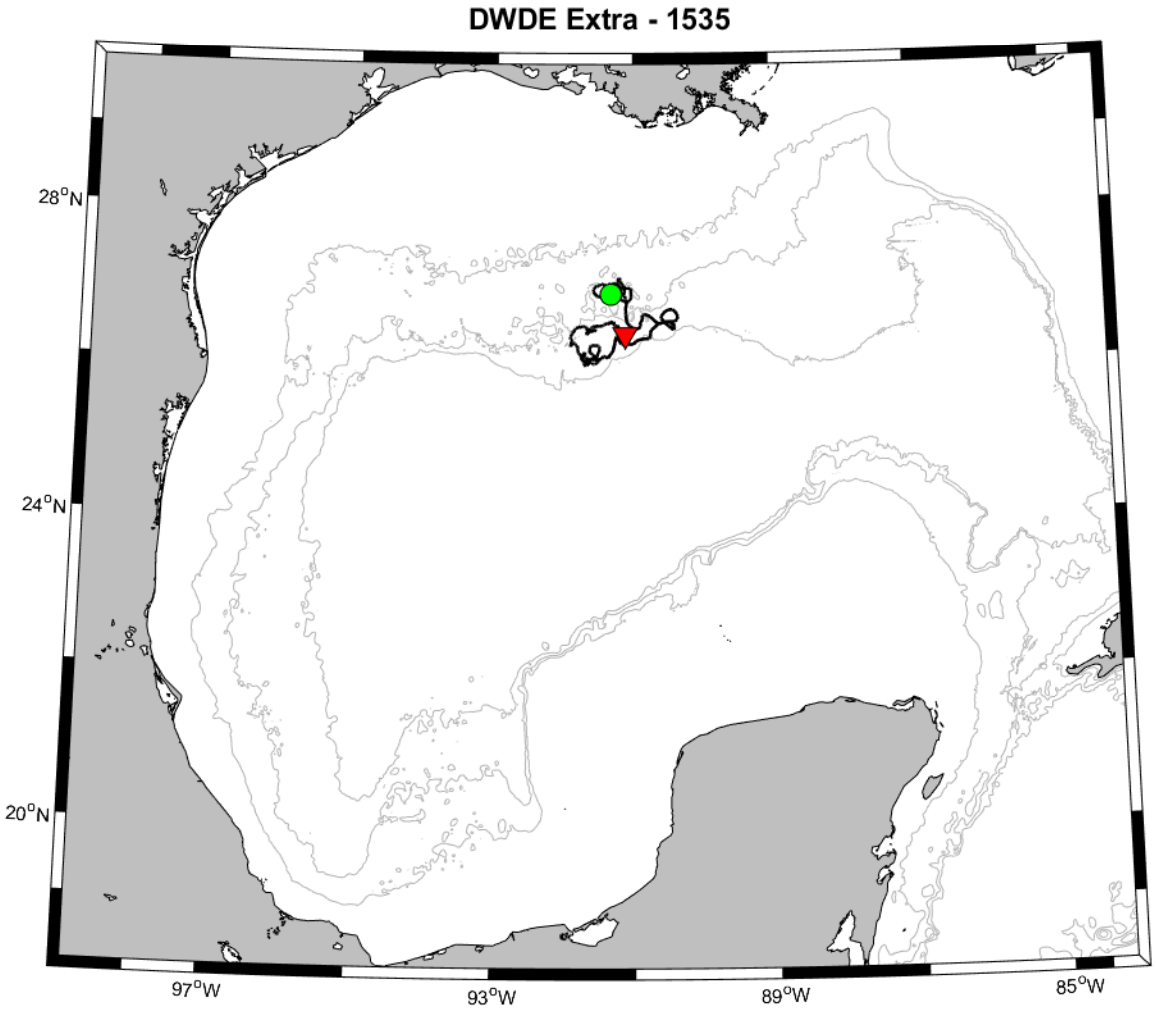


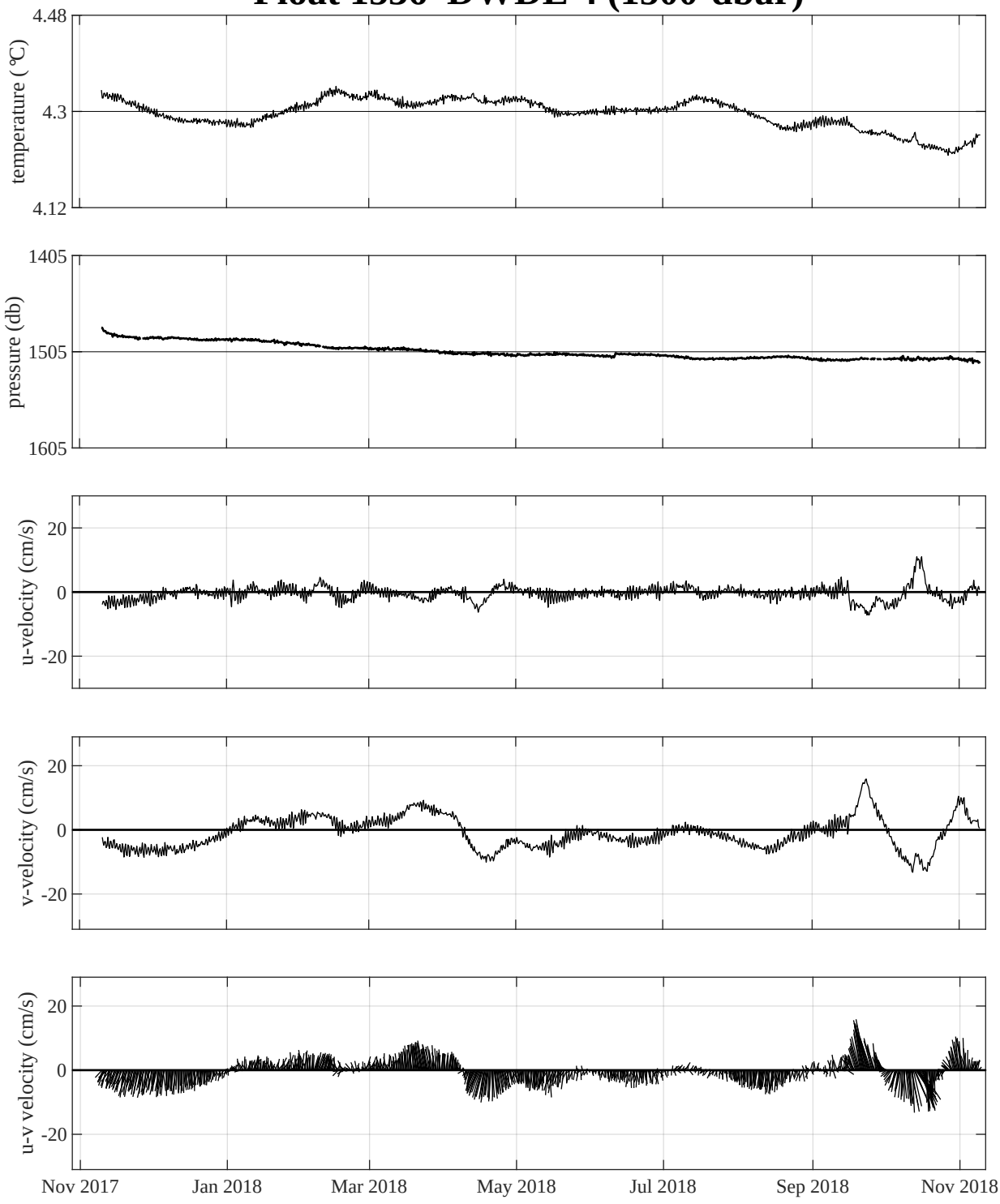

DWDE 4 - 1533
28°N
24°N
20°N
97°W
93°W
89°W
85°W

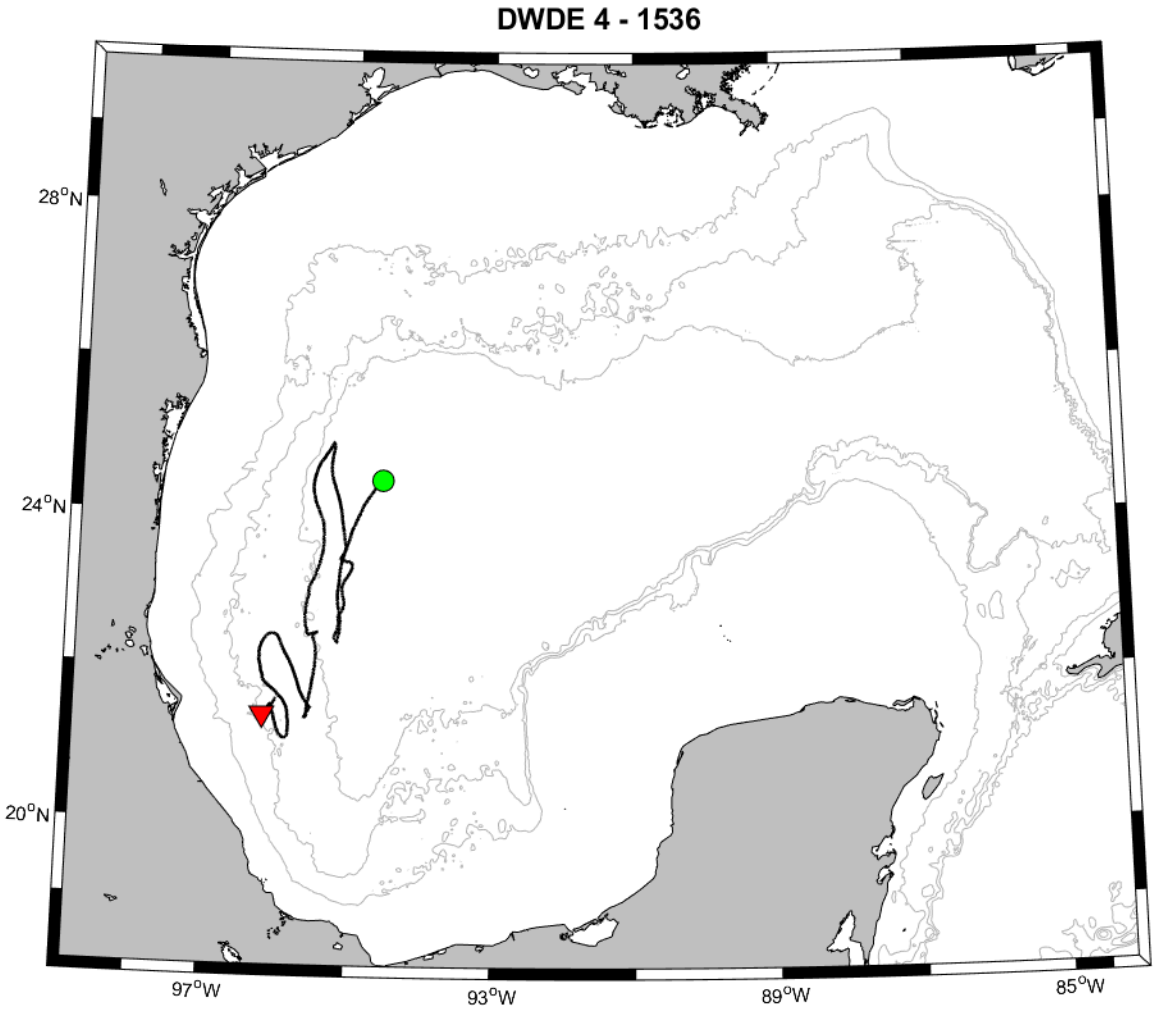

Float 1534 DWDE 4 (1500-dbar)
temperature (℃)
4.48
4.3
4.12
pressure (db)
1450
1550
1650
u-velocity (cm/s)
20
0
-20
v-velocity (cm/s)
20
0
-20
u-v velocity (cm/s)
20
0
-20
Nov 2017
Jan 2018
Mar 2018
May 2018
Jul 2018
Sep 2018
Nov 2018

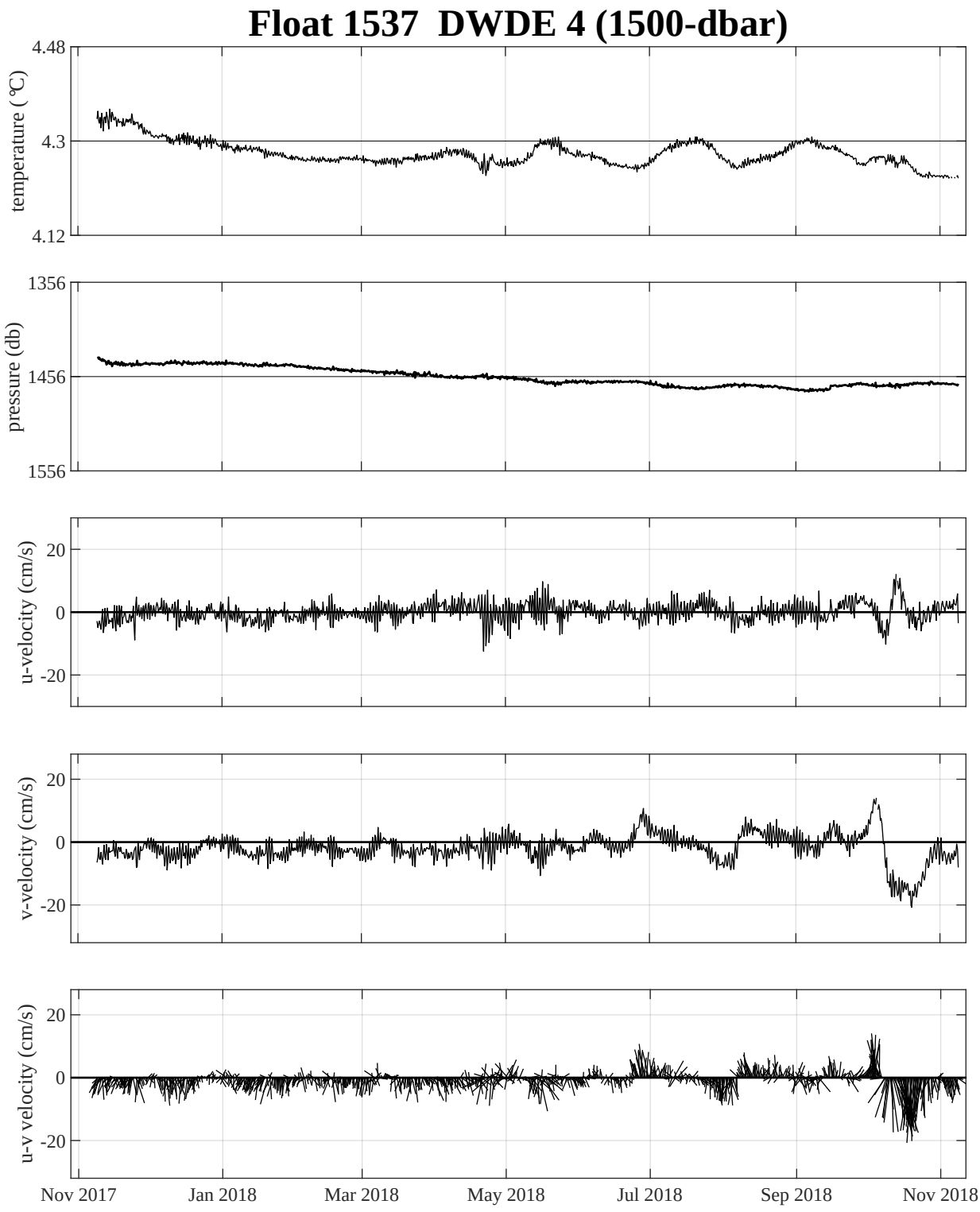

DWDE 4 - 1534
28°N
24°N
20°N
97°W
93°W
89°W
85°W

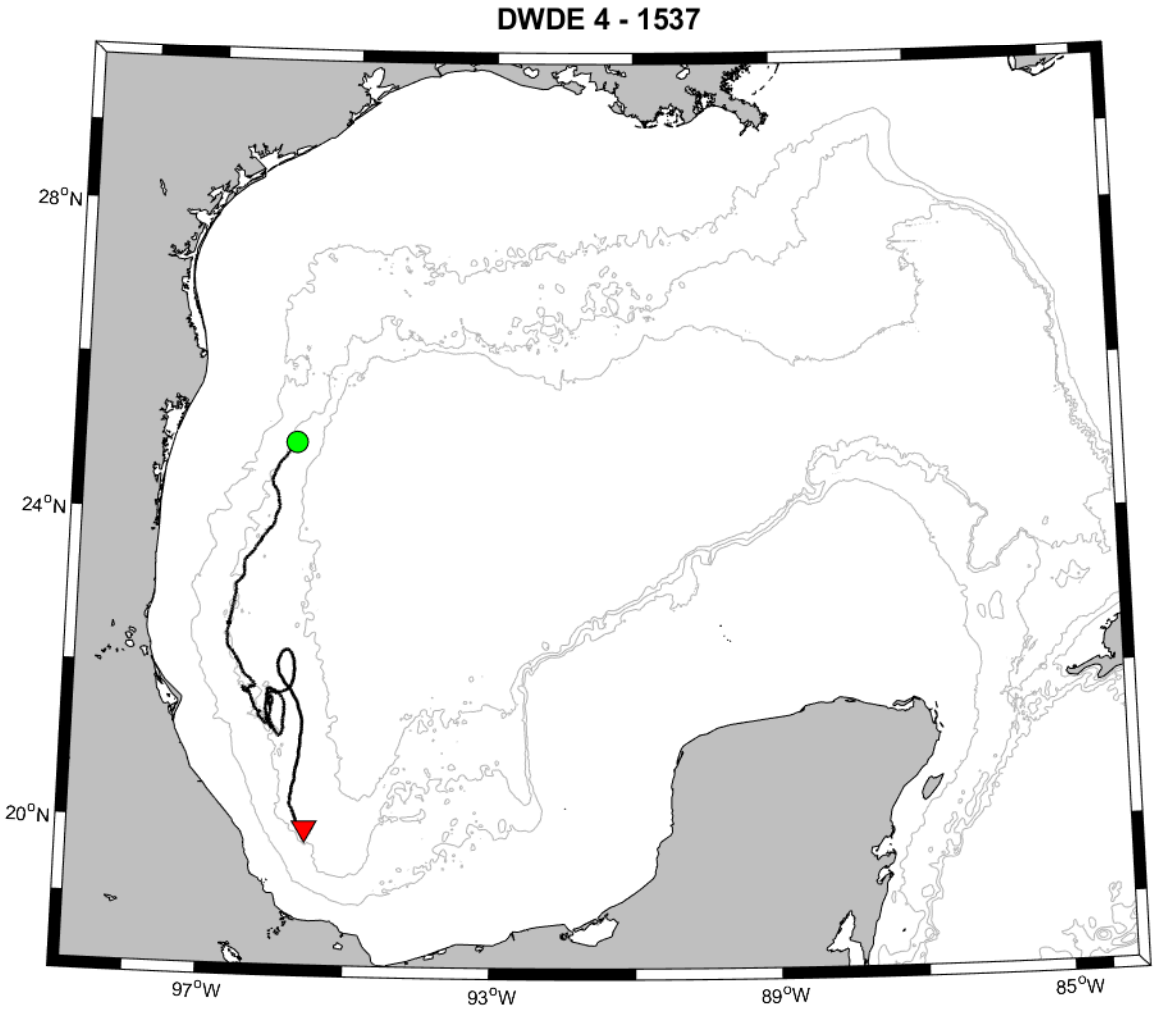

Float 1535 DWDE Extra (1500-dbar)
temperature (℃)
4.48
4.3
4.12
pressure (db)
1356
1456
1556
u-velocity (cm/s)
20
0
-20
v-velocity (cm/s)
20
0
-20
u-v velocity (cm/s)
20
0
-20
May 2018
Jul 2018
Sep 2018
Nov 2018
Jan 2019

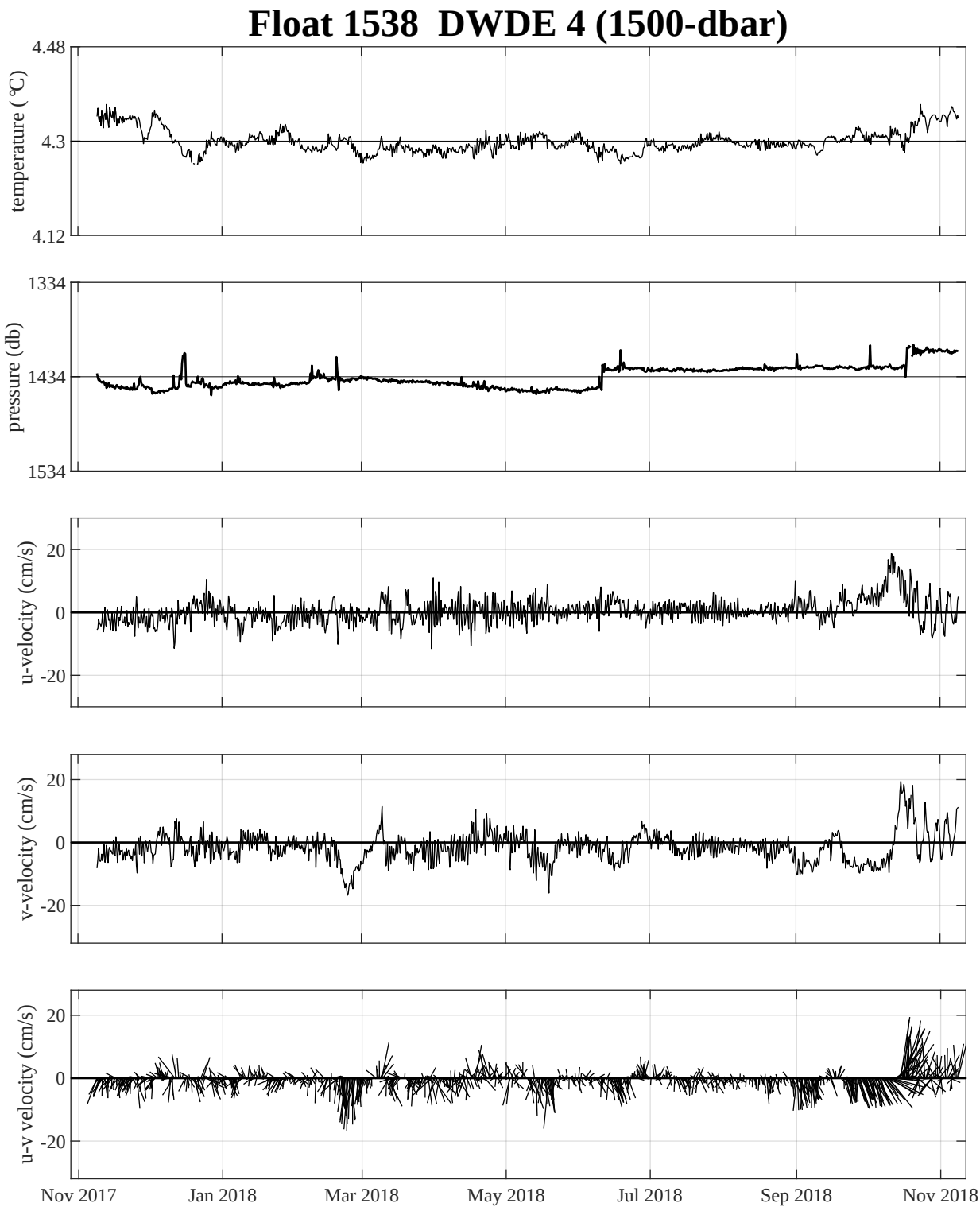

DWDE Extra - 1535
28°N
24°N
20°N
97°W
93°W
89°W
85°W

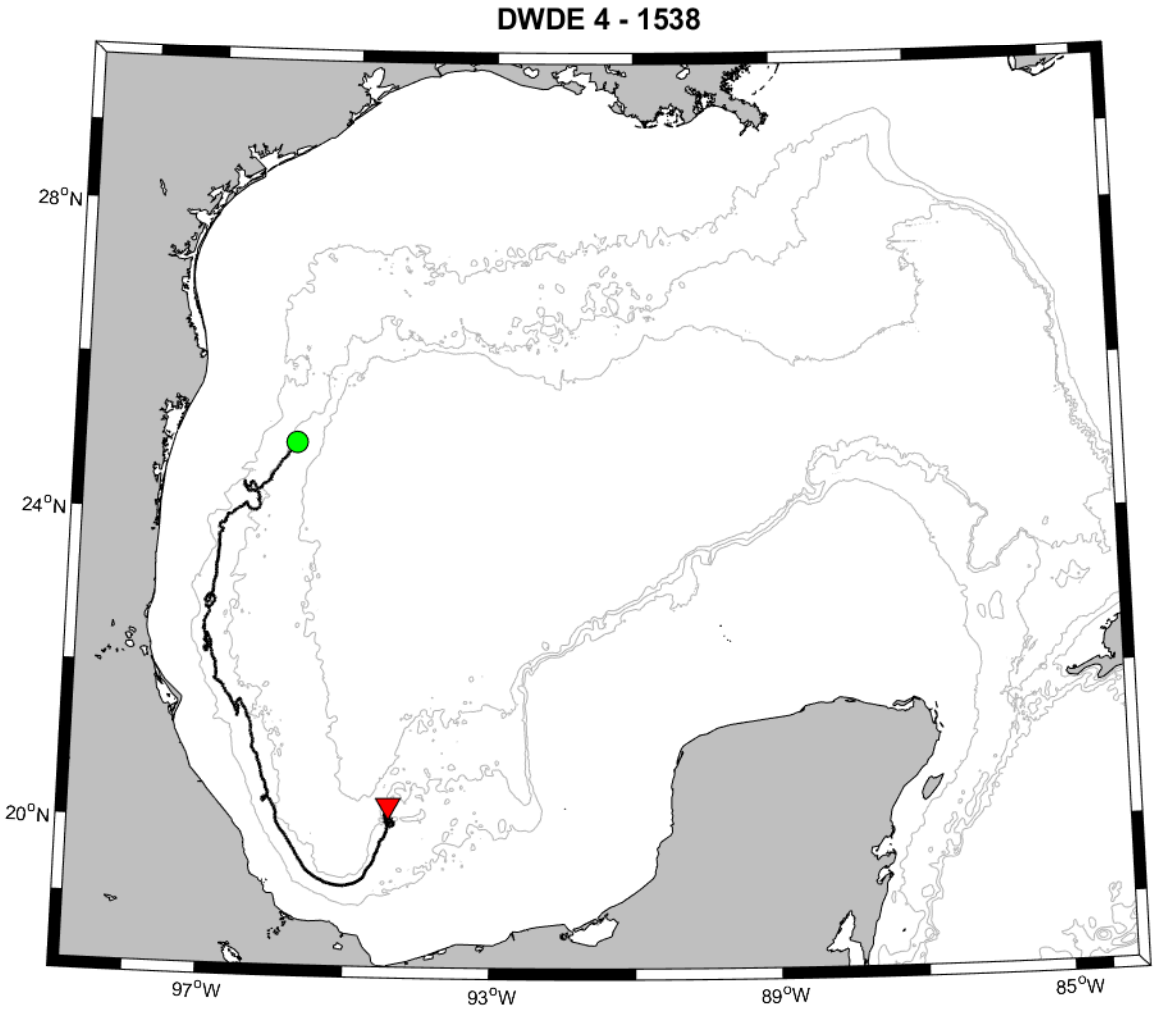

Float 1536 DWDE 4 (1500-dbar)
temperature (℃)
4.48
4.3
4.12
pressure (db)
1405
1505
1605
u-velocity (cm/s)
20
0
-20
v-velocity (cm/s)
20
0
-20
u-v velocity (cm/s)
20
0
-20
Nov 2017
Jan 2018
Mar 2018
May 2018
Jul 2018
Sep 2018
Nov 2018

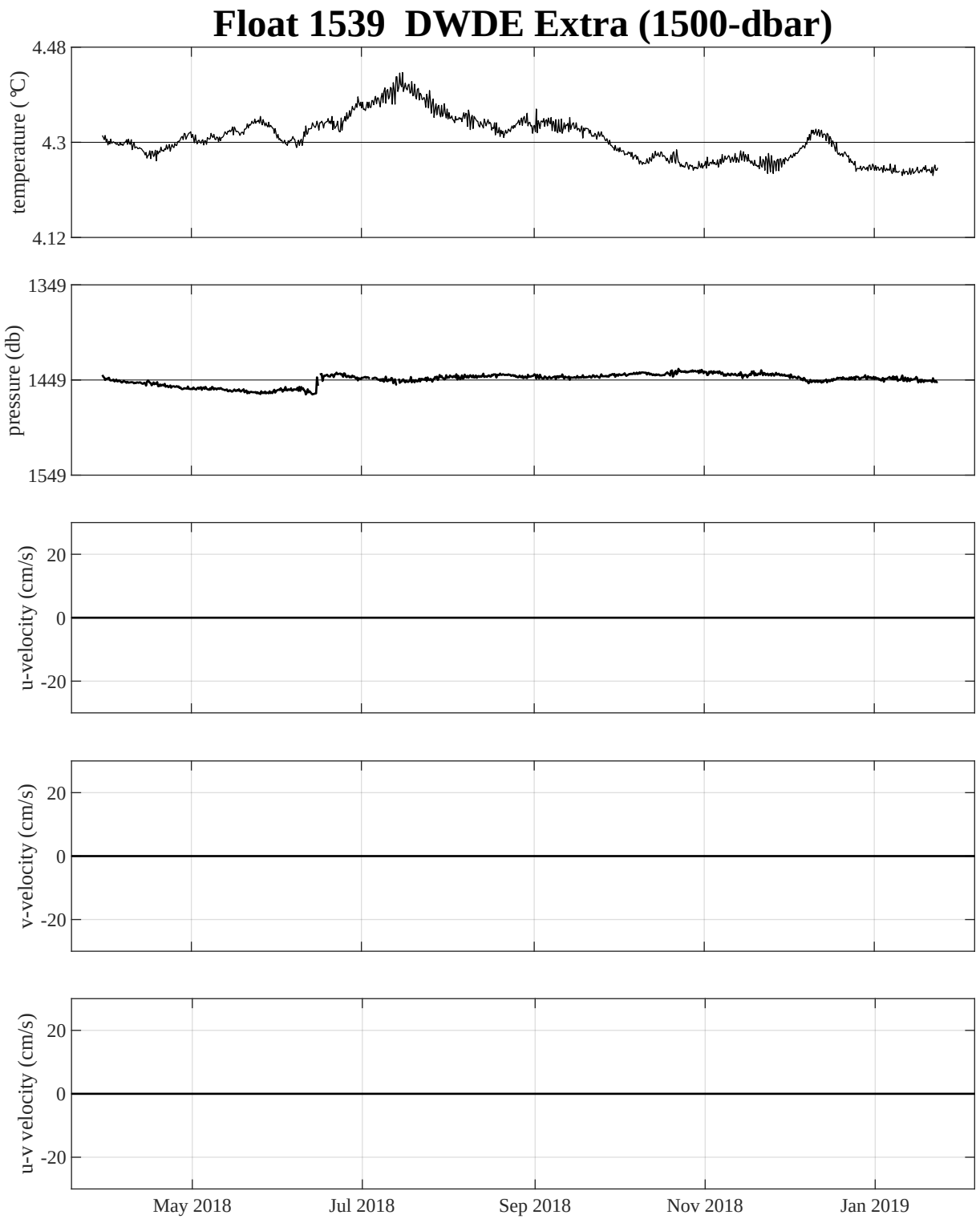

DWDE 4 - 1536
28°N
24°N
20°N
97°W
93°W
89°W
85°W

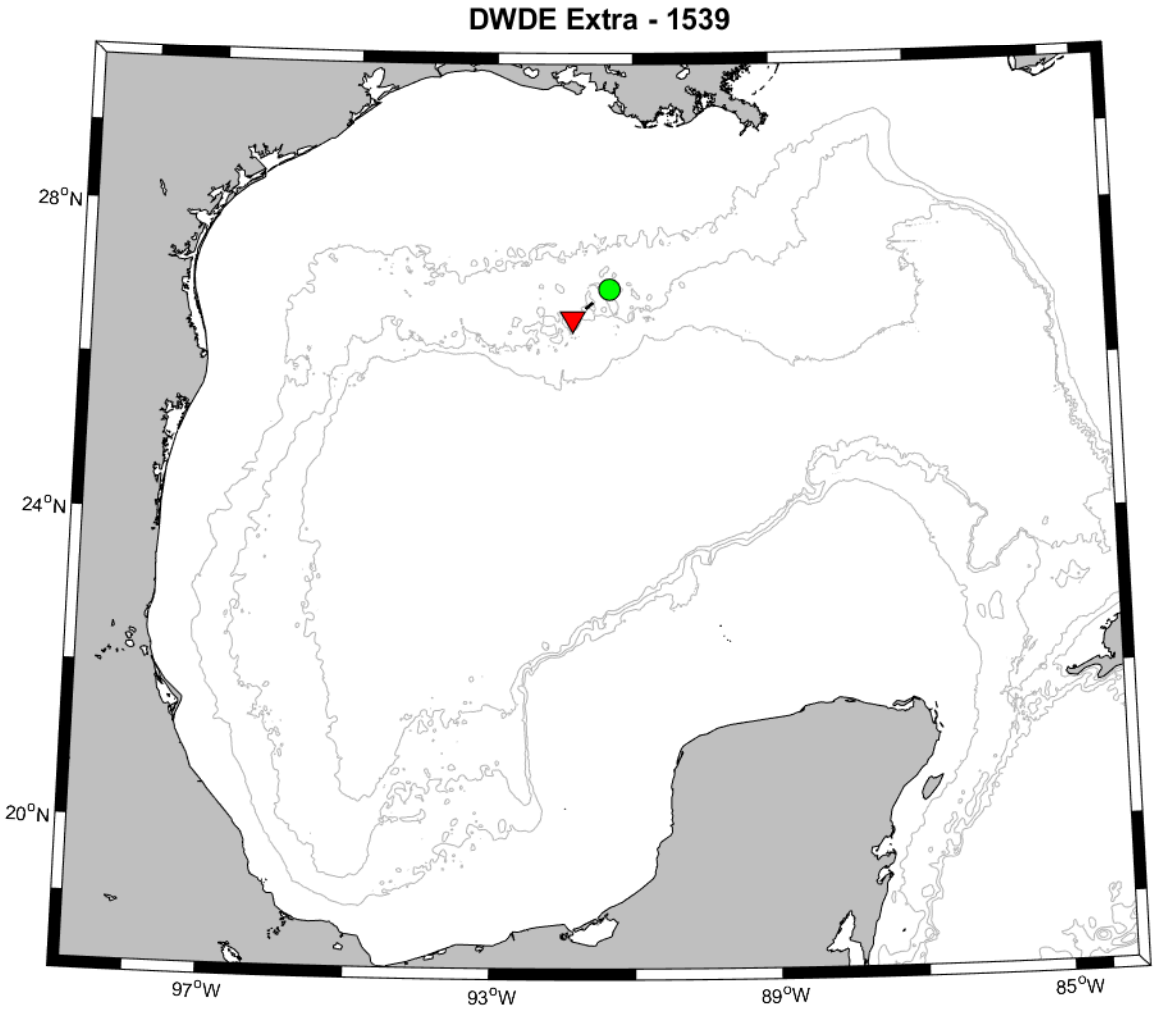

Float 1537 DWDE 4 (1500-dbar)
temperature (℃)
4.48
4.3
4.12
pressure (db)
1356
1456
1556
u-velocity (cm/s)
v-velocity (cm/s)
u-v velocity (cm/s)
20
0
-20
Nov 2017
Jan 2018
Mar 2018
May 2018
Jul 2018
Sep 2018
Nov 2018

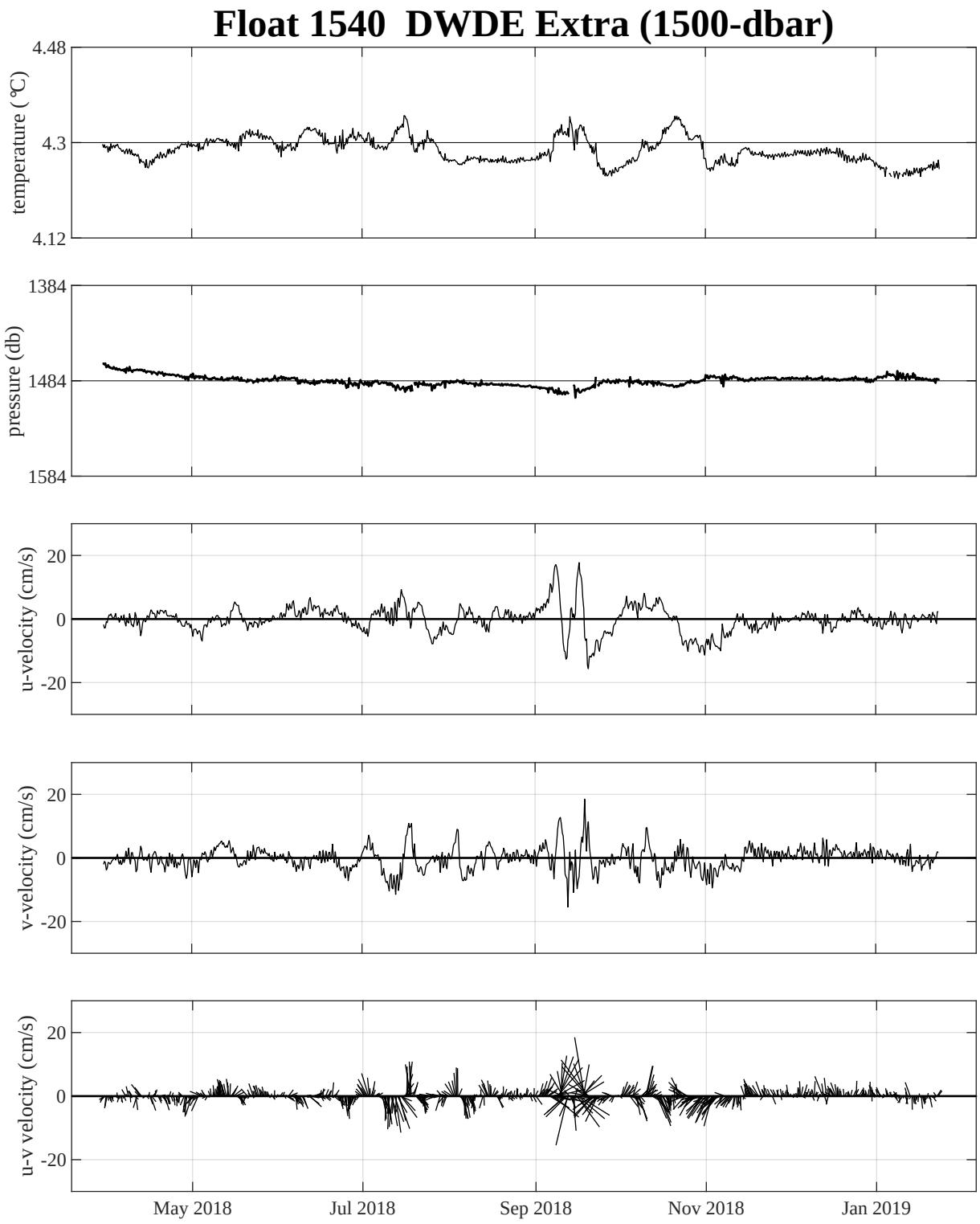

DWDE 4 - 1537
28°N
24°N
20°N
97°W
93°W
89°W
85°W

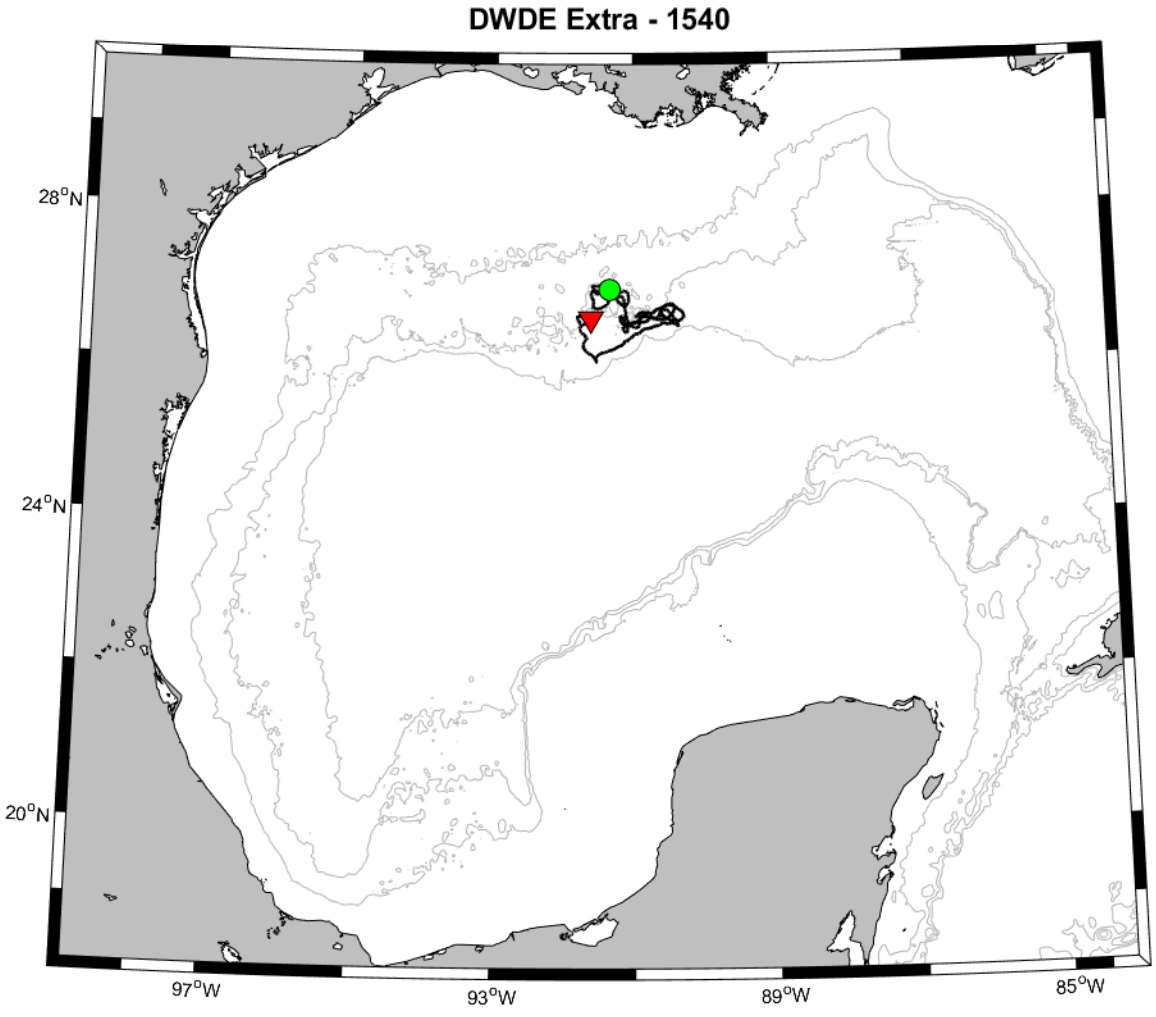

Float 1538 DWDE 4 (1500-dbar)
temperature (℃)
4.48
4.3
4.12
pressure (db)
1334
1434
1534
u-velocity (cm/s)
20
0
-20
v-velocity (cm/s)
20
0
-20
u-v velocity (cm/s)
20
0
-20
Nov 2017
Jan 2018
Mar 2018
May 2018
Jul 2018
Sep 2018
Nov 2018


DWDE 4 - 1538
28°N
24°N
20°N
97°W
93°W
89°W
85°W


Float 1539 DWDE Extra (1500-dbar)
temperature (°C)
4.48
4.3
4.12
pressure (db)
1349
1449
1549
u-velocity (cm/s)
20
0
-20
v-velocity (cm/s)
20
0
-20
u-v velocity (cm/s)
20
0
-20
May 2018
Jul 2018
Sep 2018
Nov 2018
Jan 2019


DWDE Extra - 1539
28°N
24°N
20°N
97°W
93°W
89°W
85°W

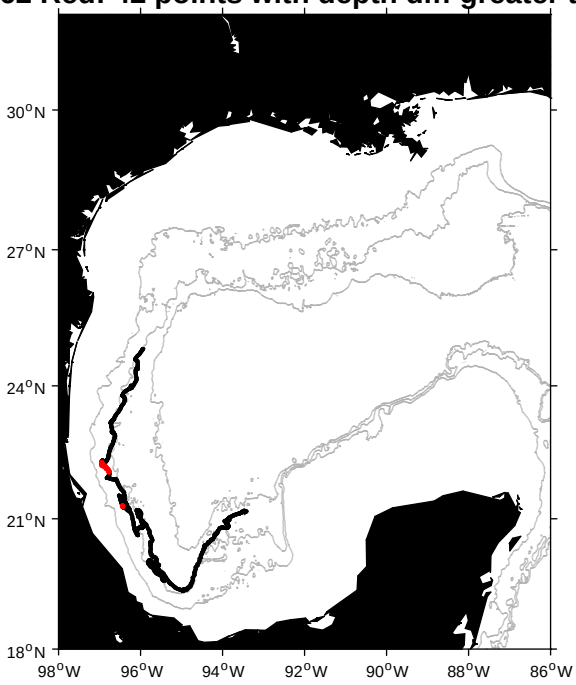

Float 1540 DWDE Extra (1500-dbar)
temperature (°C)
4.48
4.3
4.12
pressure (db)
1384
1484
1584
u-velocity (cm/s)
20
0
-20
v-velocity (cm/s)
20
0
-20
u-v velocity (cm/s)
20
0
-20
May 2018
Jul 2018
Sep 2018
Nov 2018
Jan 2019

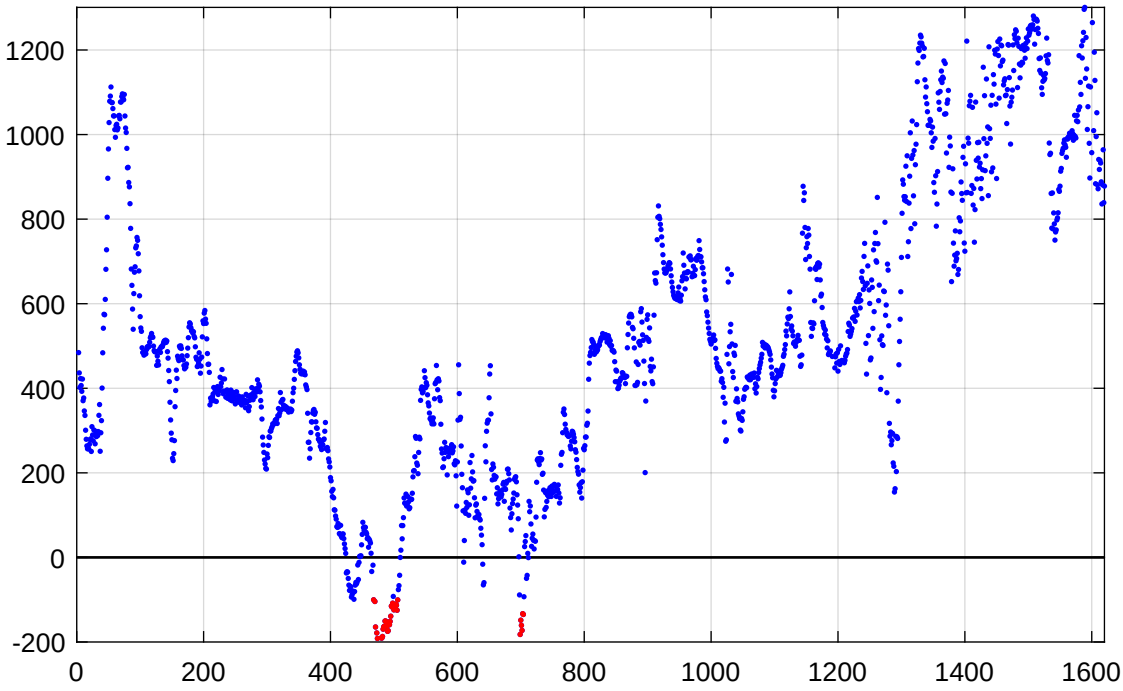

DWDE Extra - 1540
28°N
24°N
20°N
97°W
93°W
89°W
85°W

APPENDIX I: DEPTH QUALITY CONTROL PLOTS

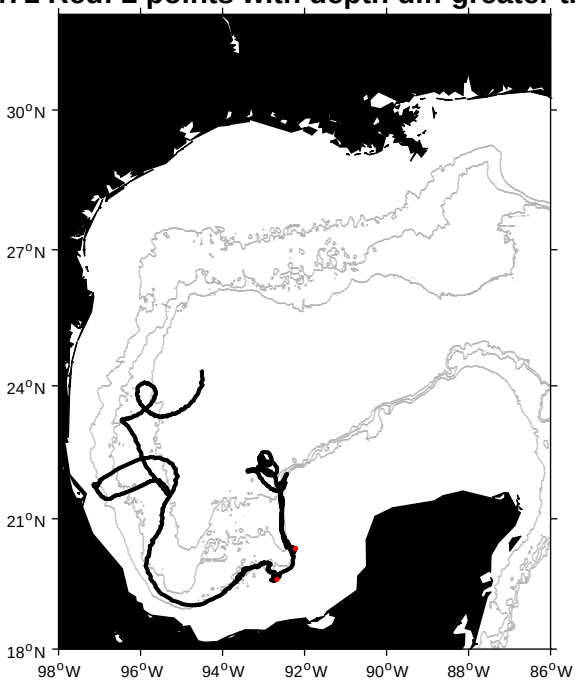
This appendix contains plots of float trajectories (upper) and depth difference (lower) of the thirteen floats that had measured depths greater than the interpolated ETOPO2 depth data base. In the upper panel, if a float track position had measured depth at least 100 meters greater than the ETOPO2 depth, then that position is colored red. In the lower panel, the difference between seafloor and float measured depth is negative where the float measures greater depth than the seafloor data. Again, only data points with depth differences below 100 meters difference are colored red.

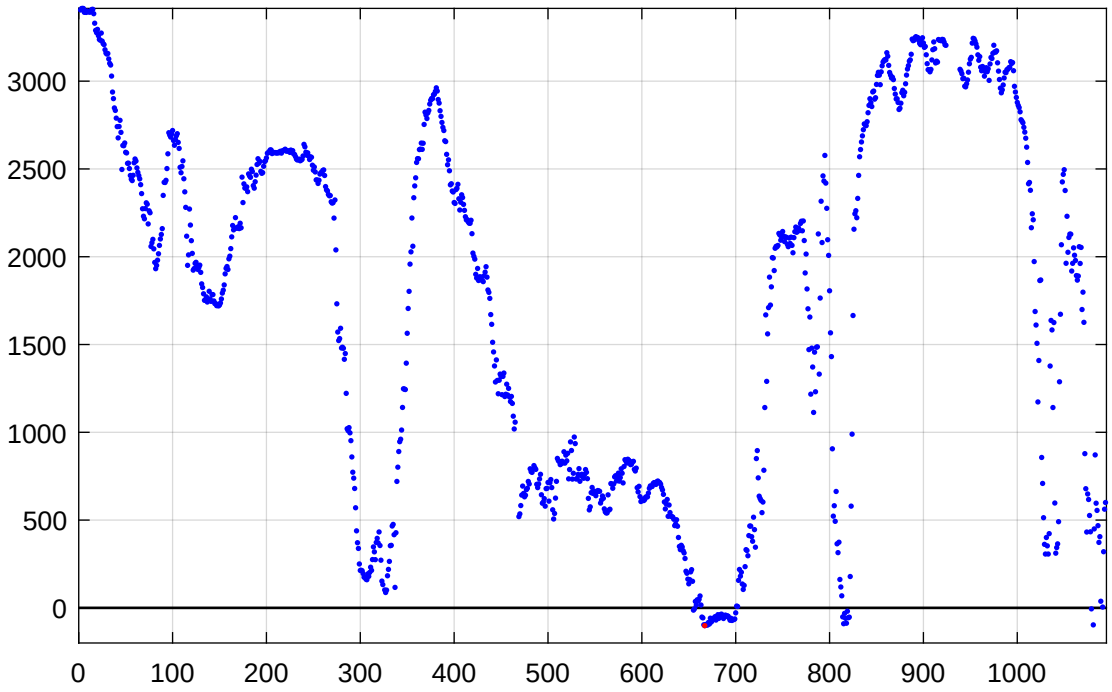
Float 1462 Red: 42 points with depth diff greater than 100 m



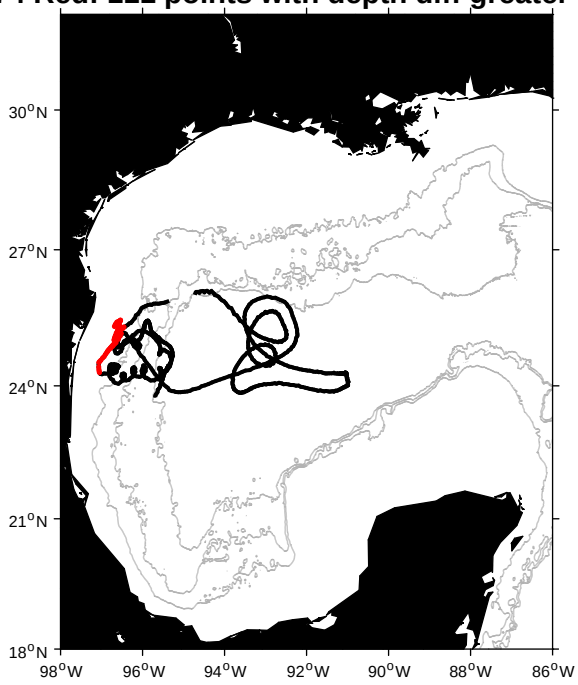


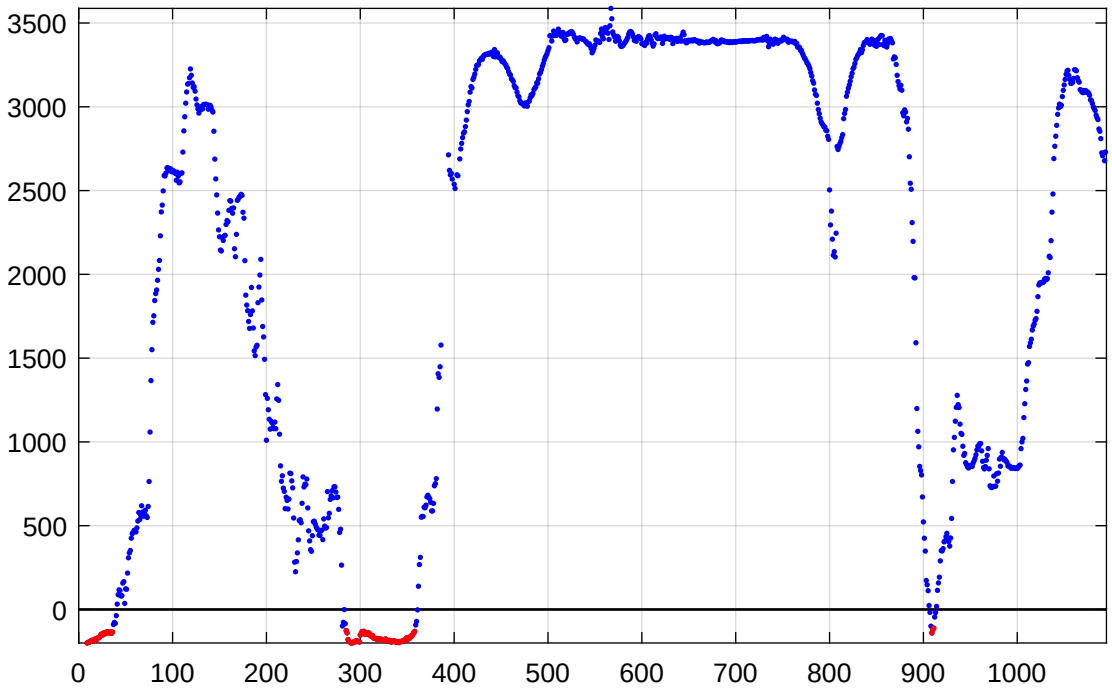
Float 1471 Red: 2 points with depth diff greater than 100 m



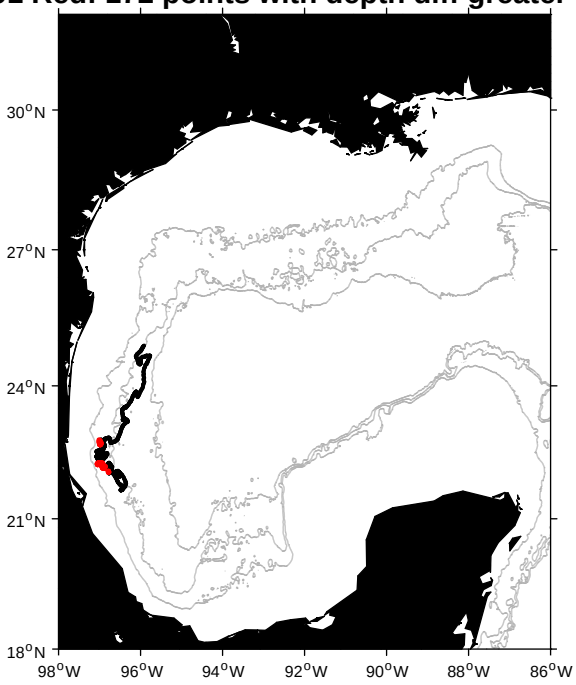


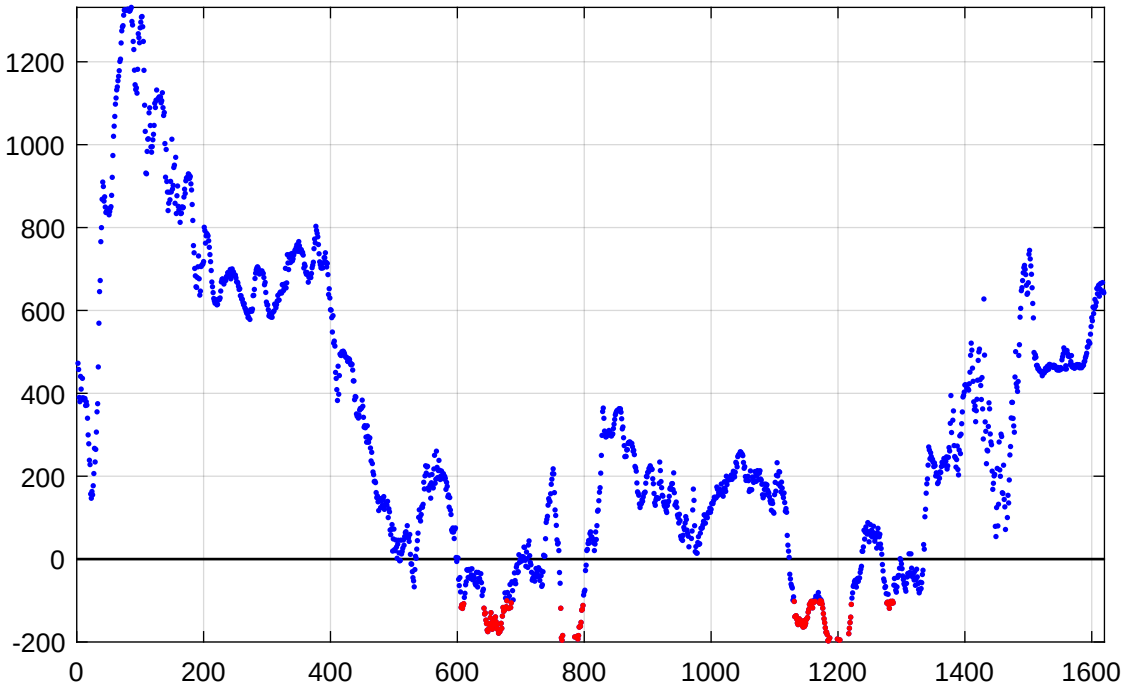
Float 1474 Red: 111 points with depth diff greater than 100 m



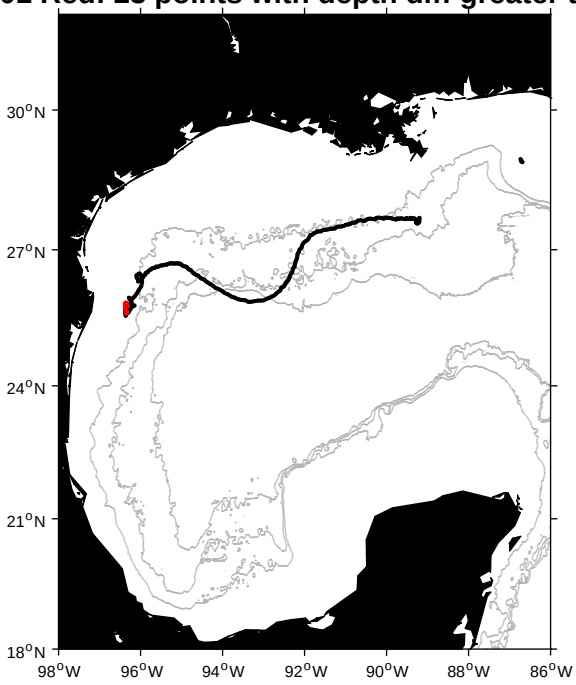


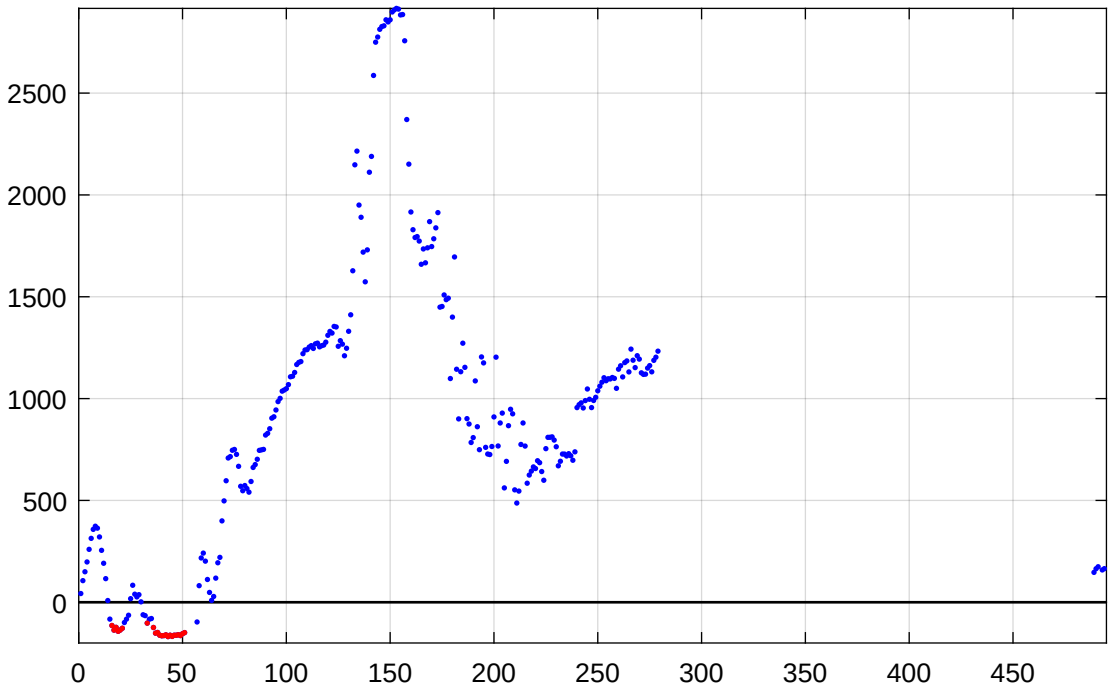
Float 1491 Red: 172 points with depth diff greater than 100 m



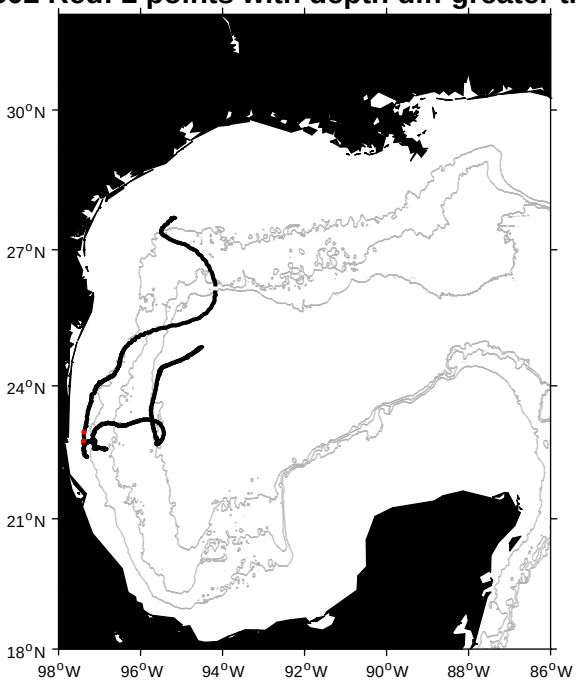


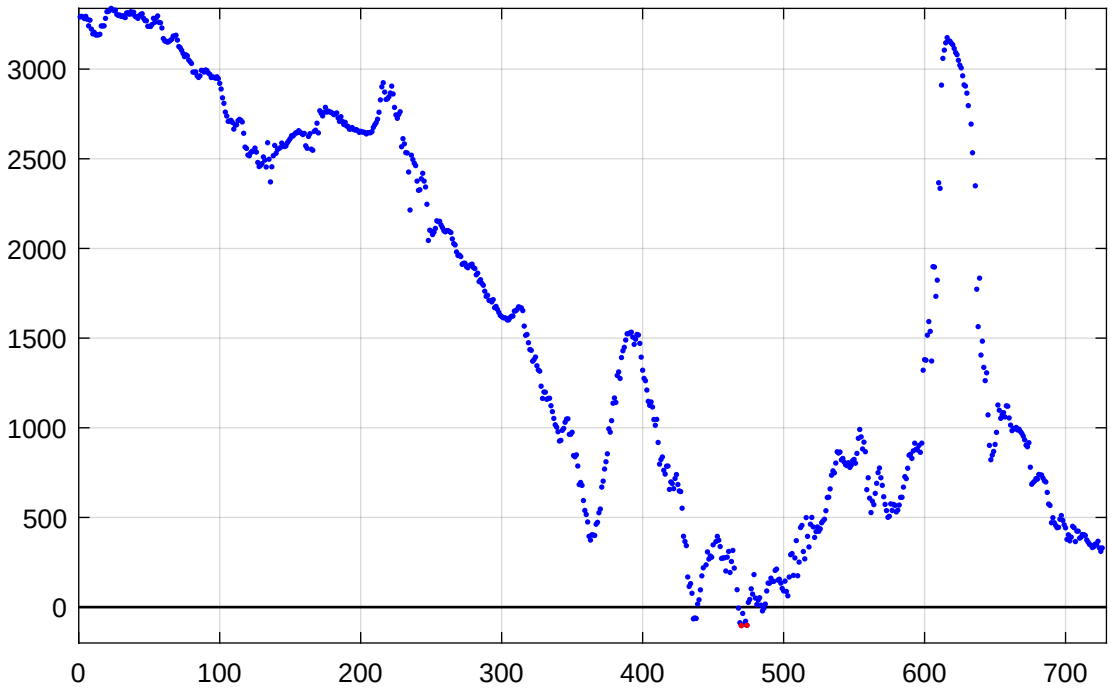
Float 1501 Red: 23 points with depth diff greater than 100 m



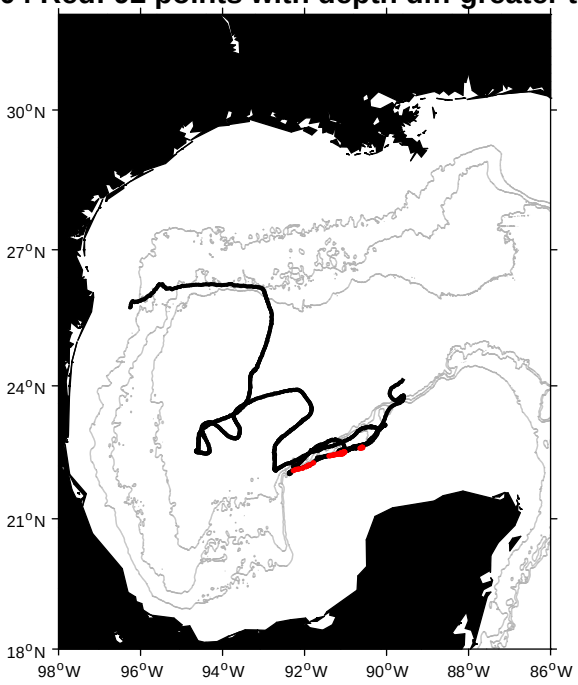


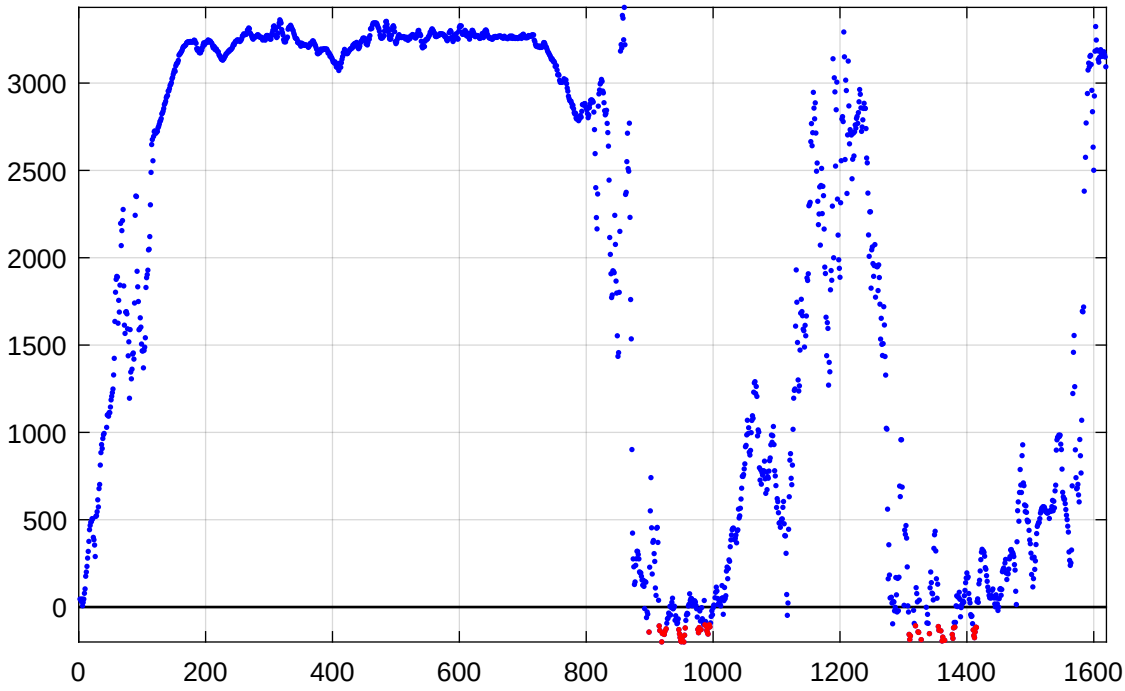
Float 1502 Red: 2 points with depth diff greater than 100 m



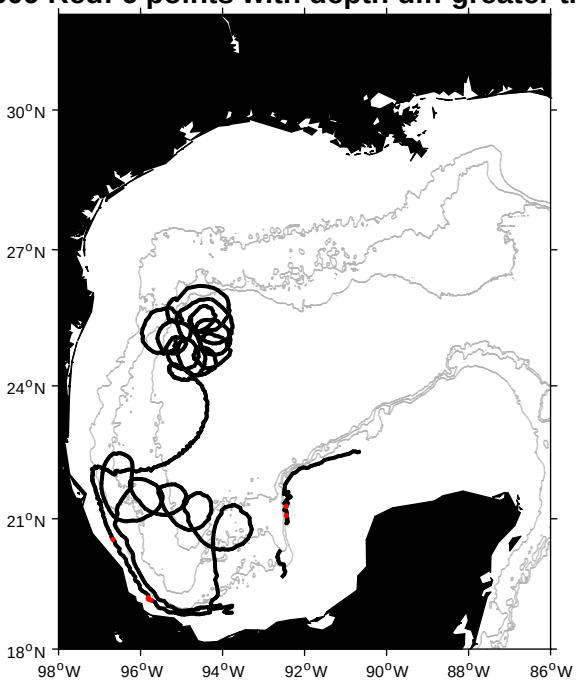


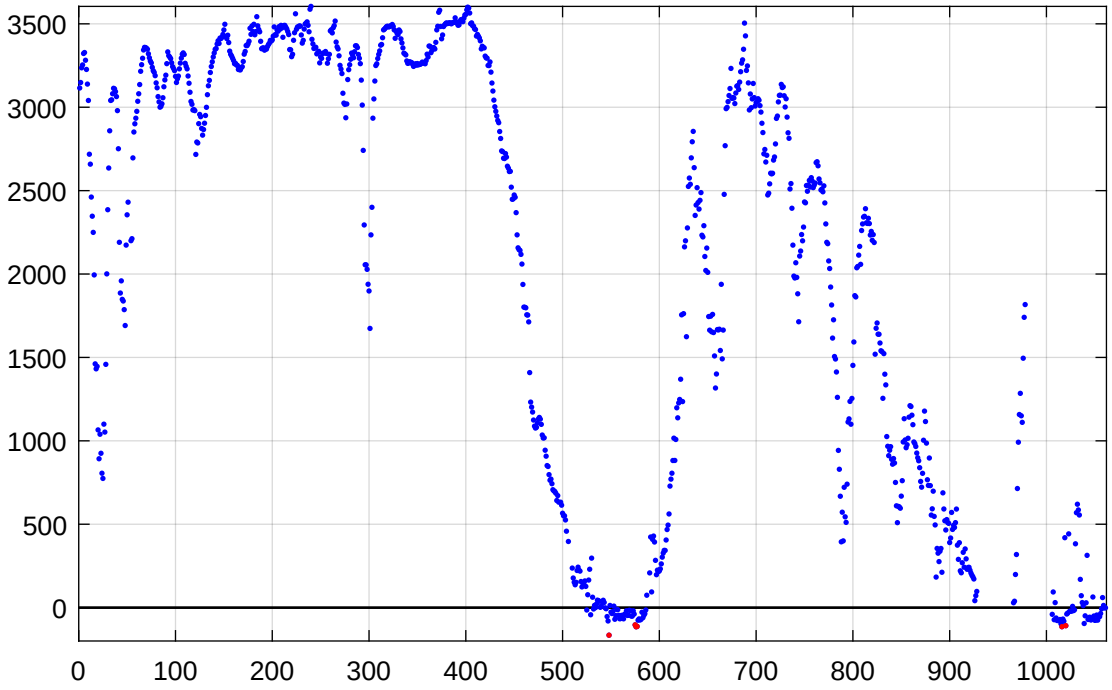
Float 1504 Red: 92 points with depth diff greater than 100 m



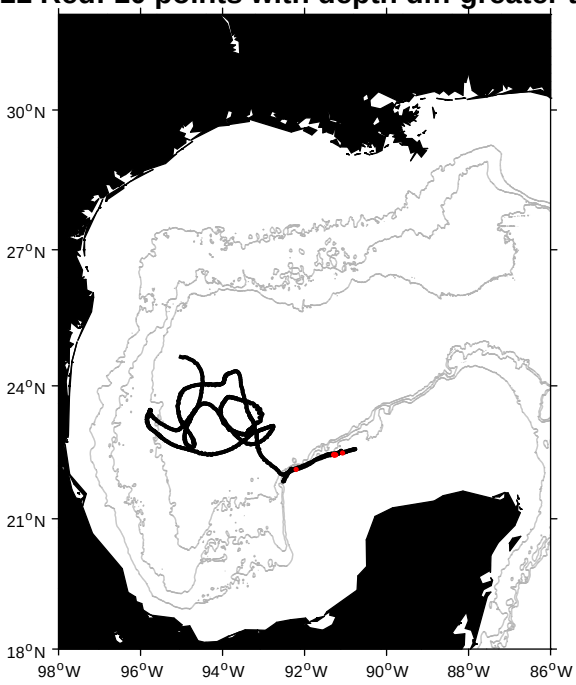


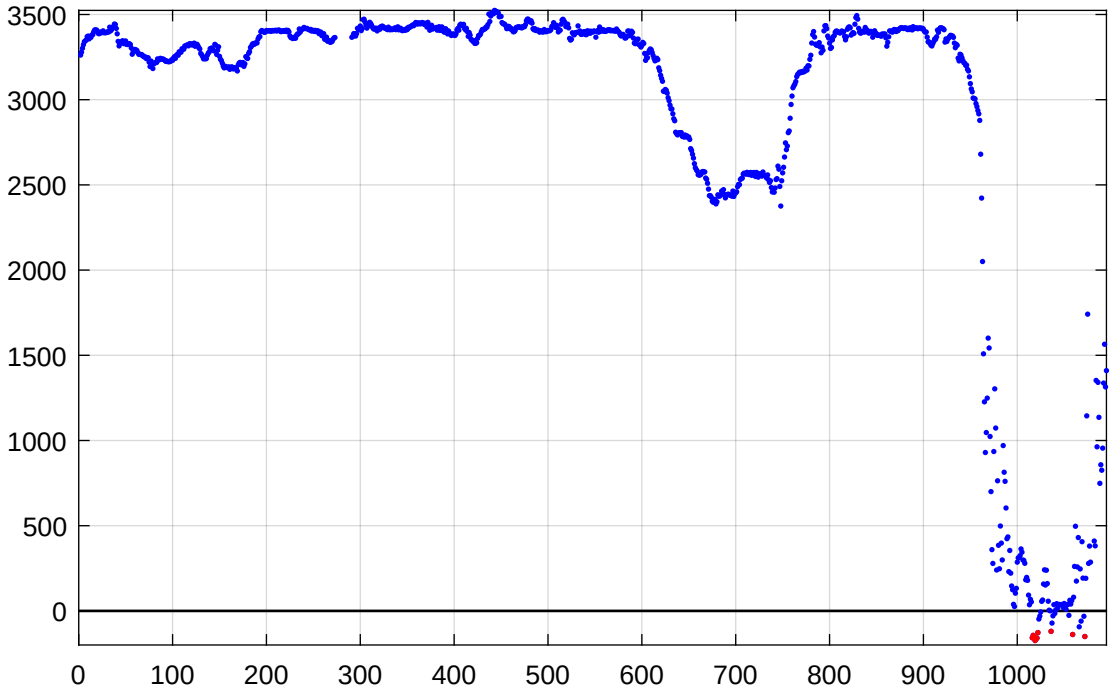
Float 1509 Red: 6 points with depth diff greater than 100 m



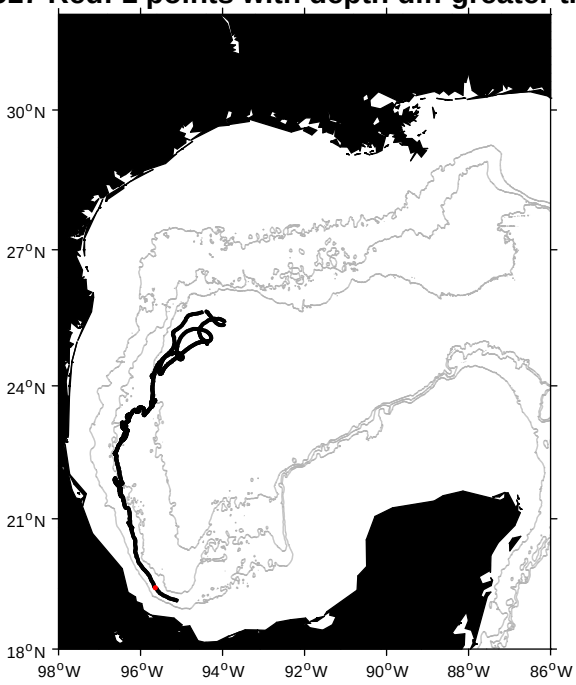


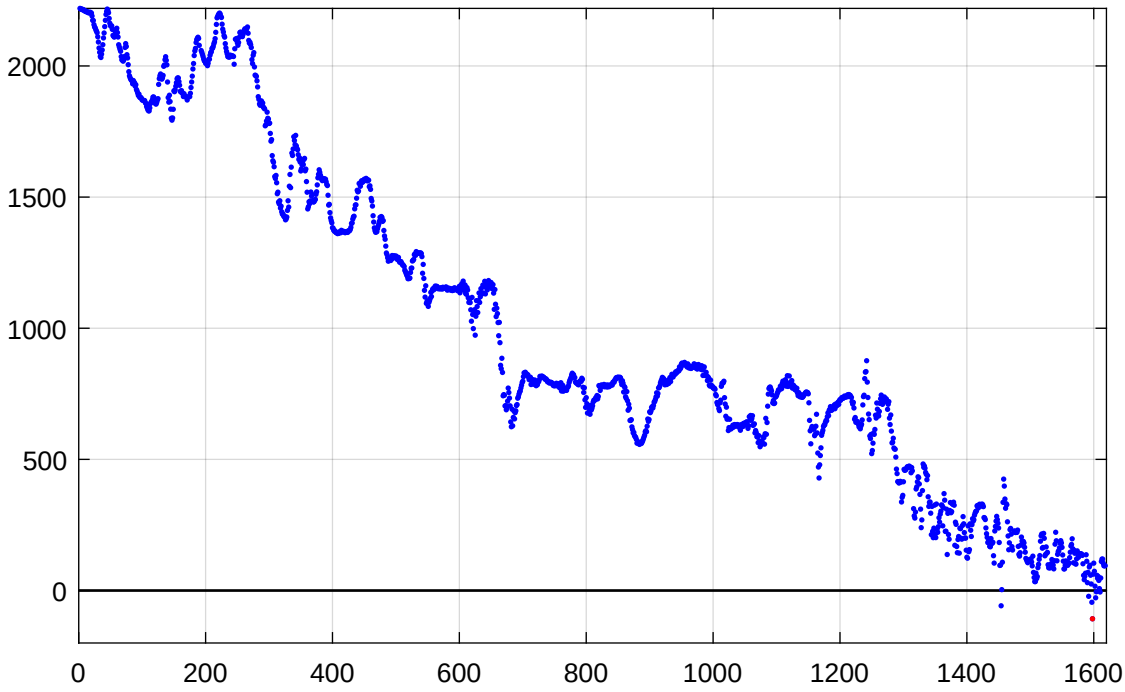
Float 1511 Red: 10 points with depth diff greater than 100 m



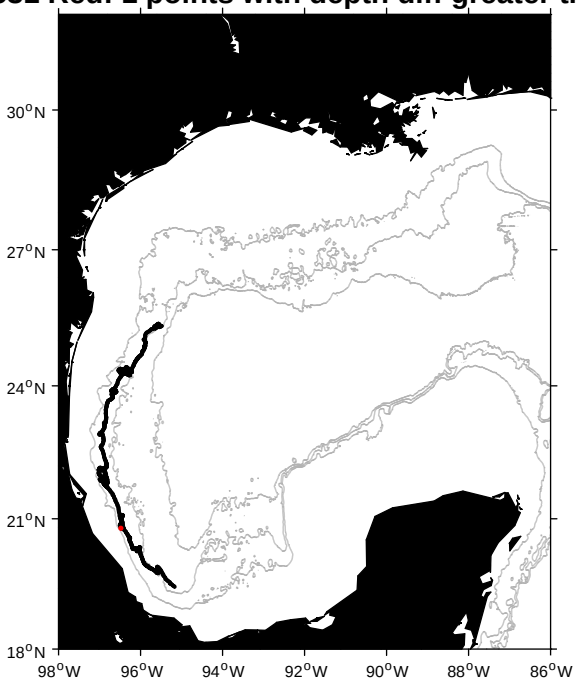


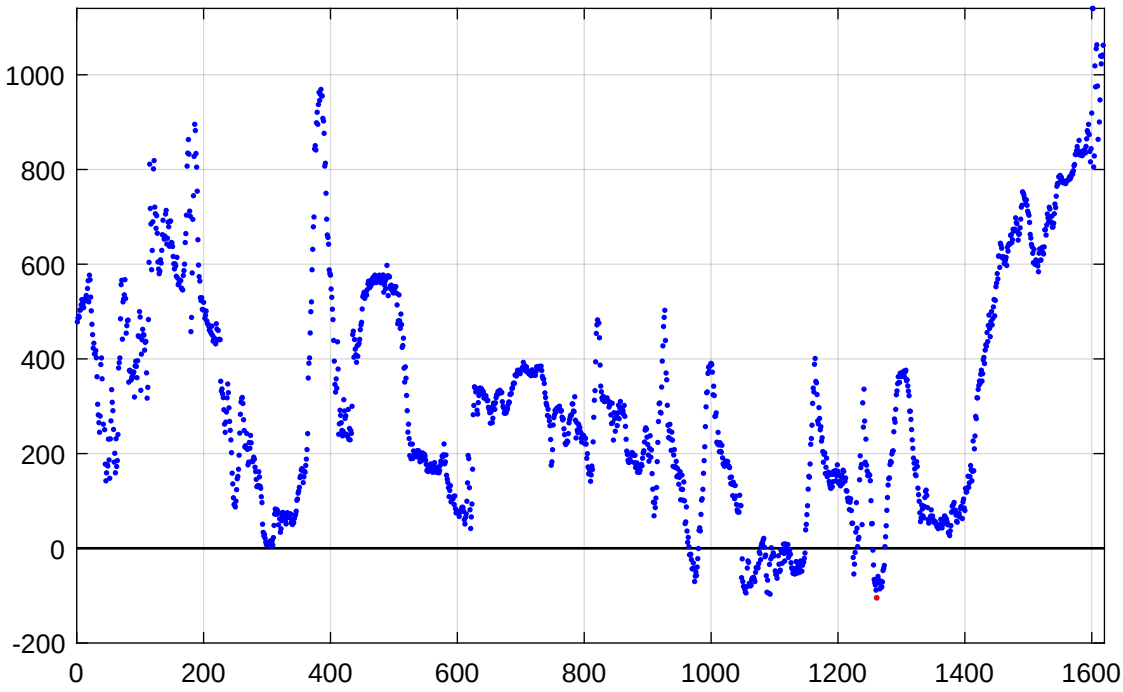
Float 1517 Red: 1 points with depth diff greater than 100 m



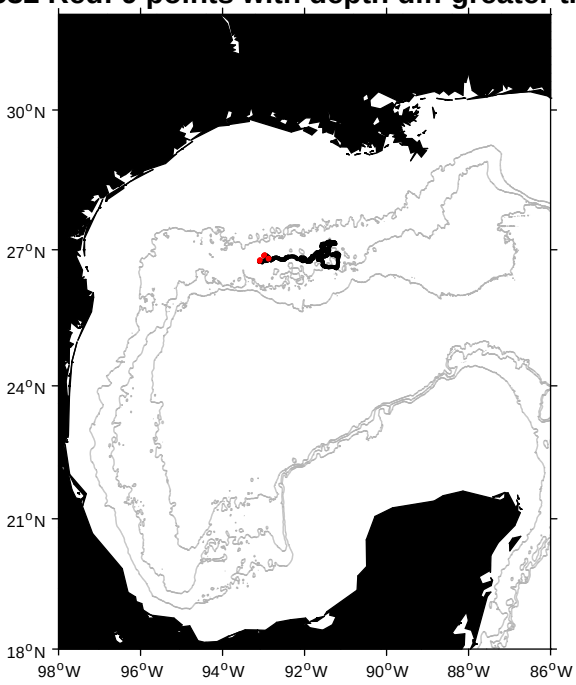


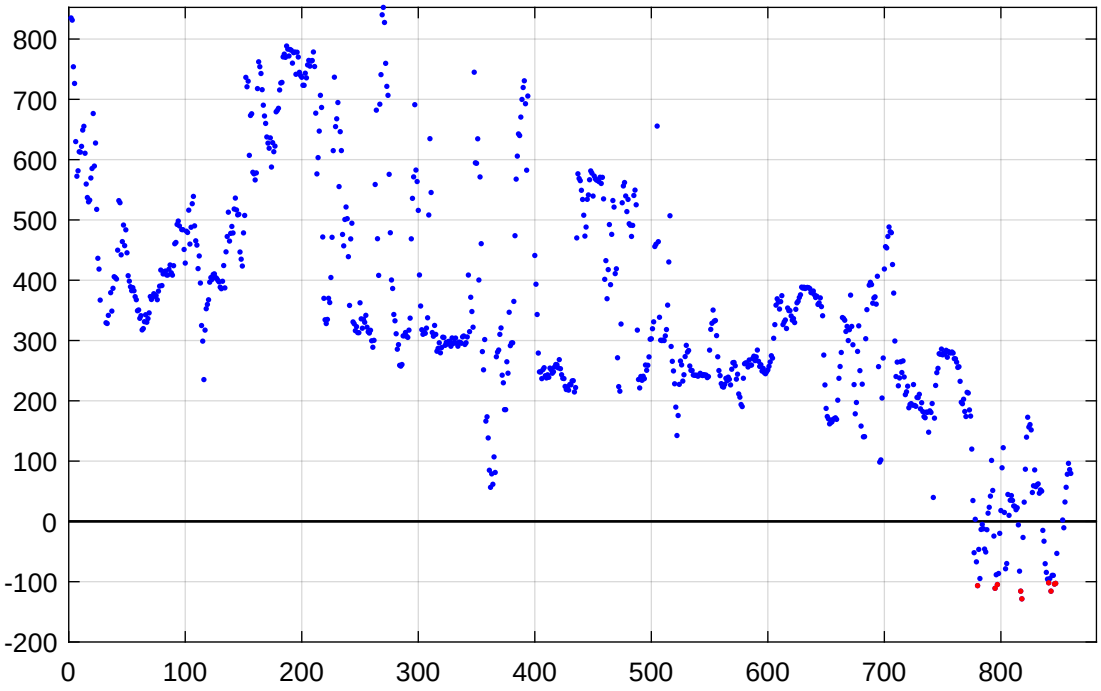
Float 1531 Red: 1 points with depth diff greater than 100 m



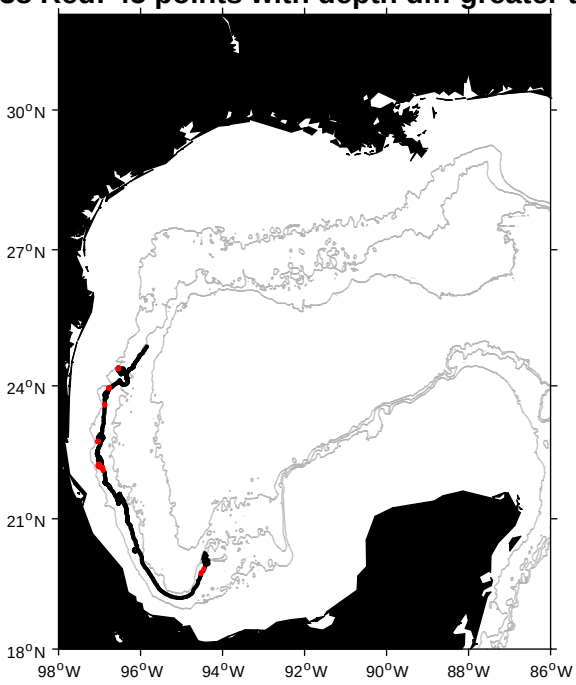


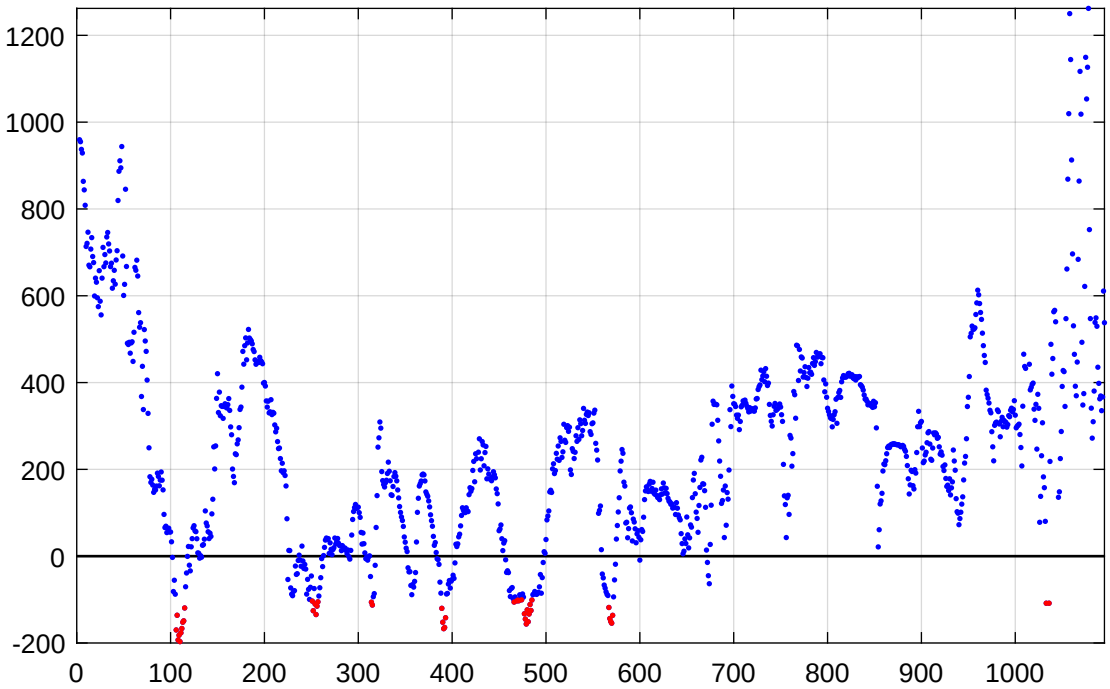
Float 1532 Red: 9 points with depth diff greater than 100 m





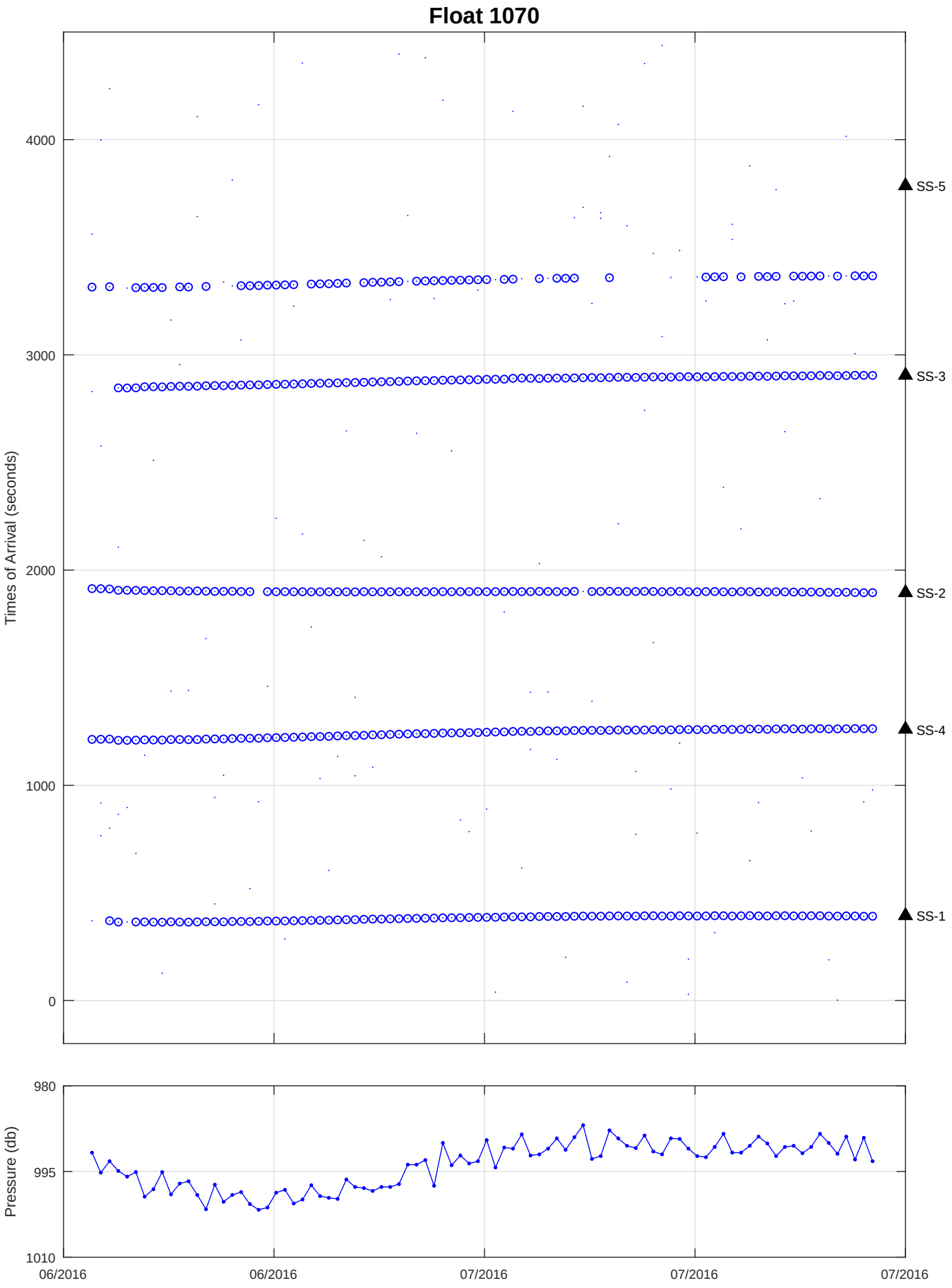
Float 1538 Red: 45 points with depth diff greater than 100 m

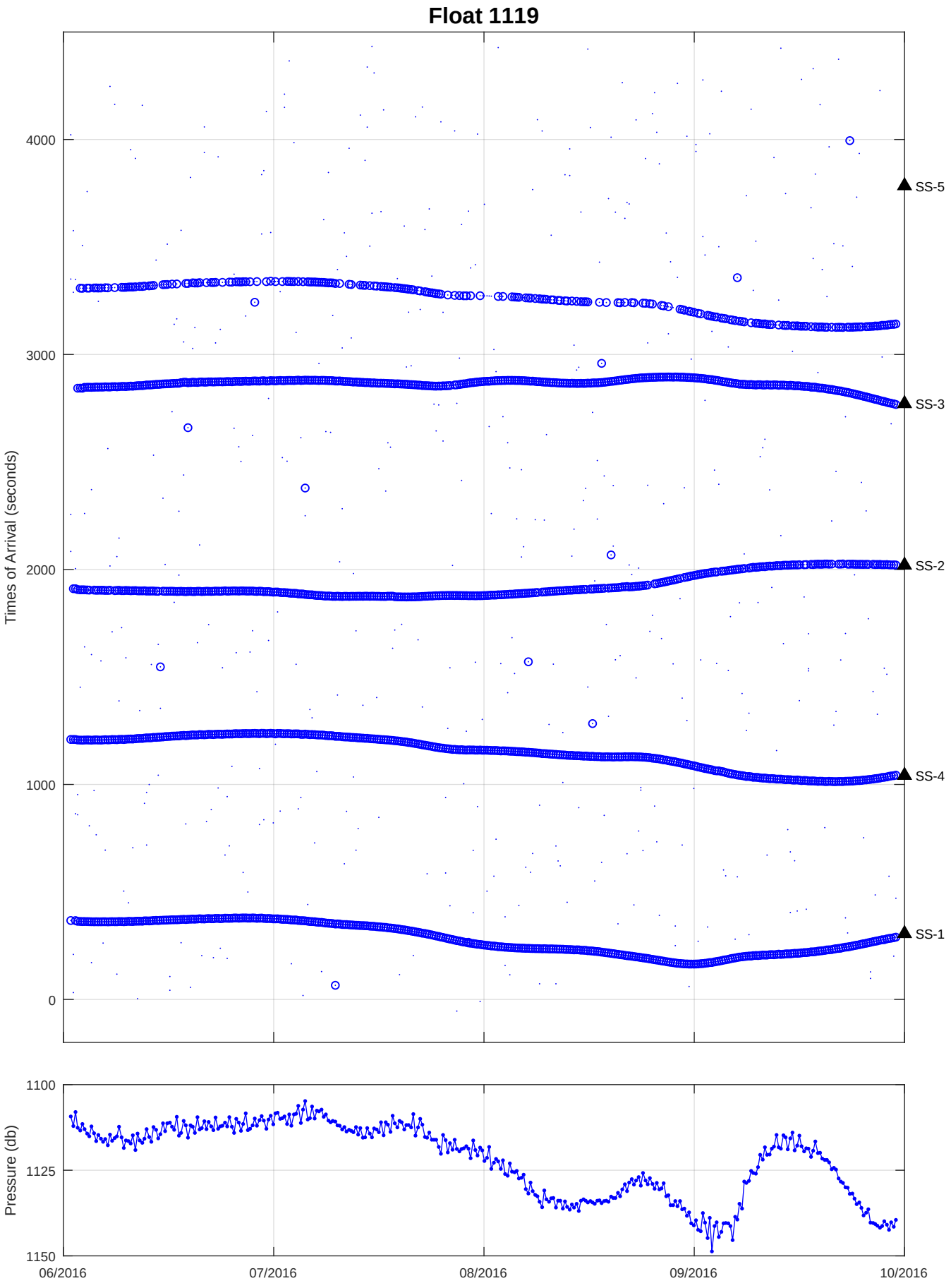


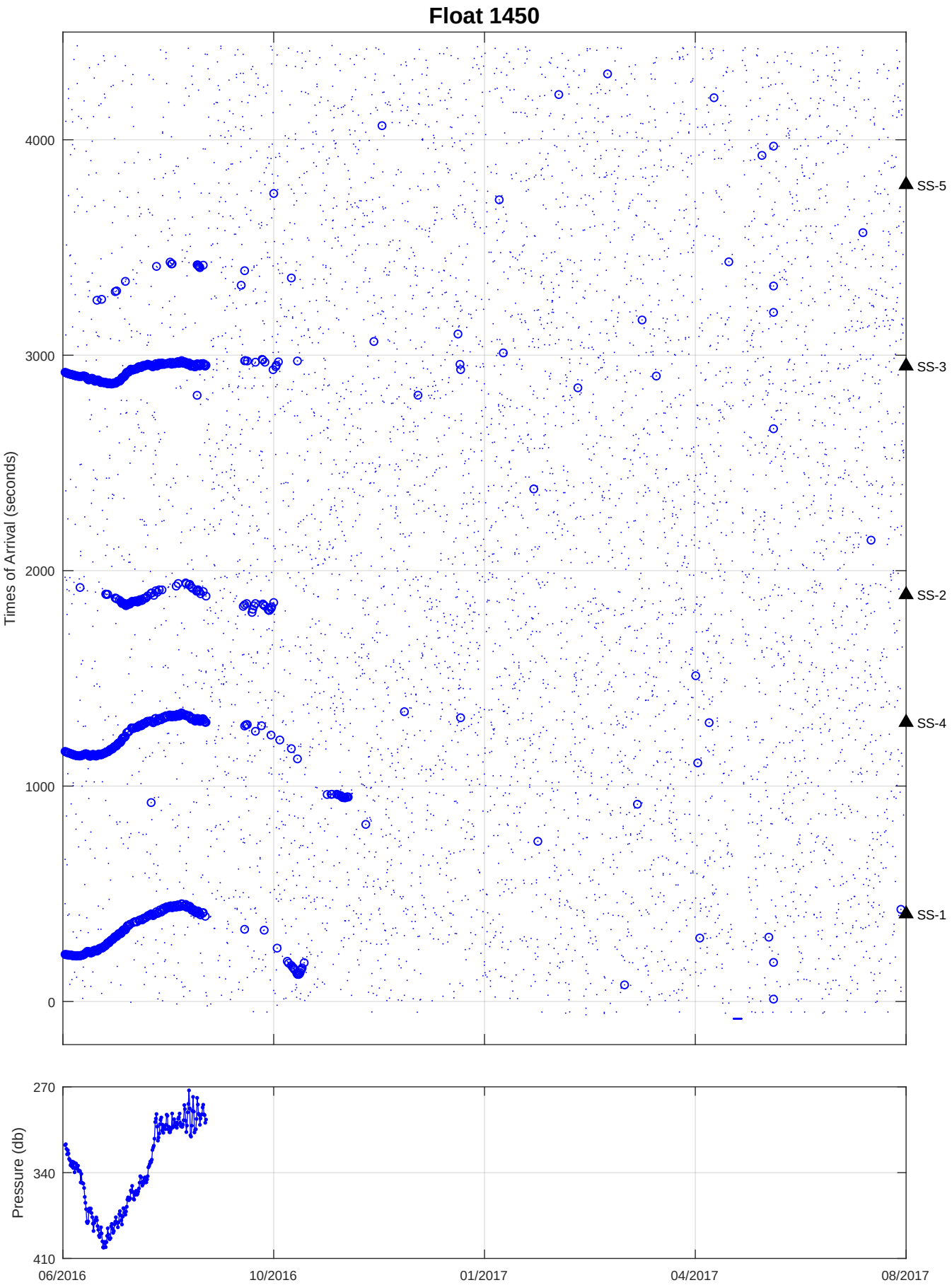


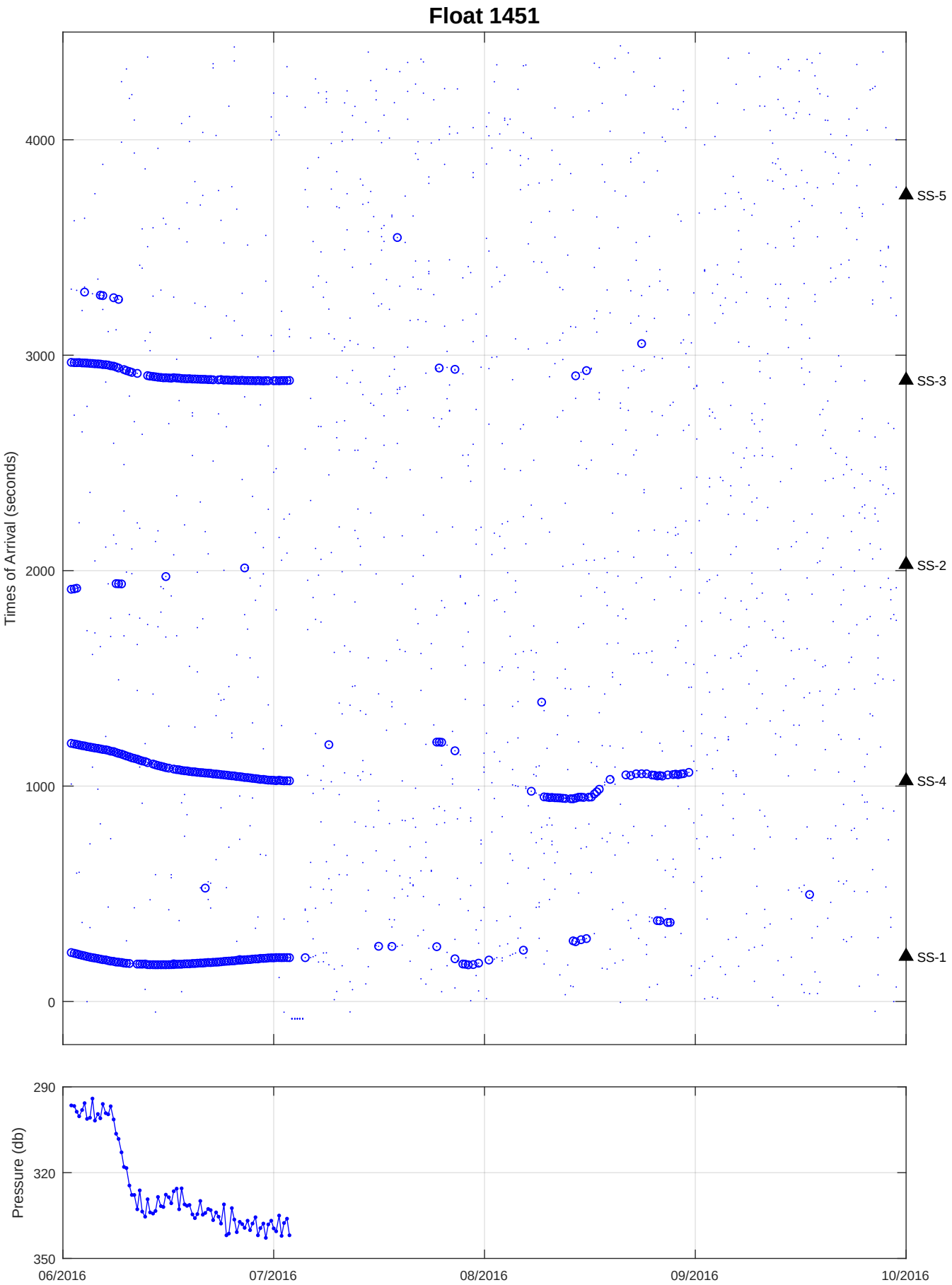
APPENDIX J: TIMES-OF-ARRIVALS

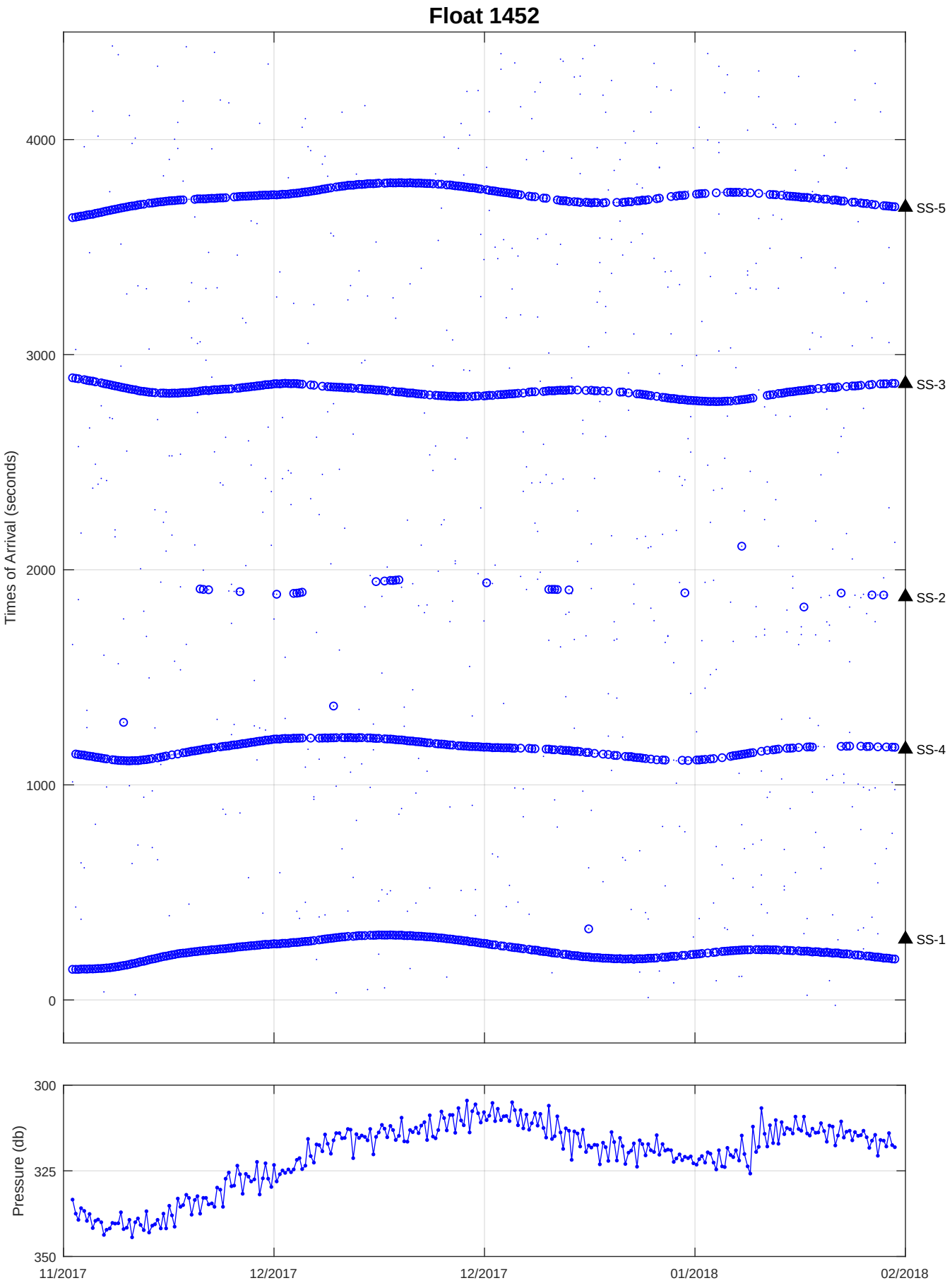
This appendix includes times-of-arrival data for each float tracked in this experiment. The data are plotted as single dots for each TOA recorded by the float, and those TOAS with strong correlations are circled. The sound source that is the source of each signal is drawn on the right hand side of each plot, and the signal position is derived from the floats surface location. Time is along the x-axis, and signal arrival time is along the y-axis. Pressure is plotted separately at the bottom, and can indicate when a float was grounded. The signal for sound source five 'SS-5' is only found in the latter half of this program, as the source was moored during DWDE-4. (For example, for float SN 1119, there is no signal at the position of SS-5, but for float SN 1453, there is.) Also on the TOA plot for float 1119, a moderate strength signal resides between SS-4 and SS-5. This is the signal from the remnant source SS-BOEM, moored during a previous RAFOS program and not recovered due to acoustic release failure (see position of SS-BOEM in Figure 2). The TOA plot for float 1450 shows strong signals during the beginning of the record, and weak signals during the end of the record. This is an example of a float being underwater for only the first part of its mission (as indicated by the pressure record), and floating on the surface for the remaining time.

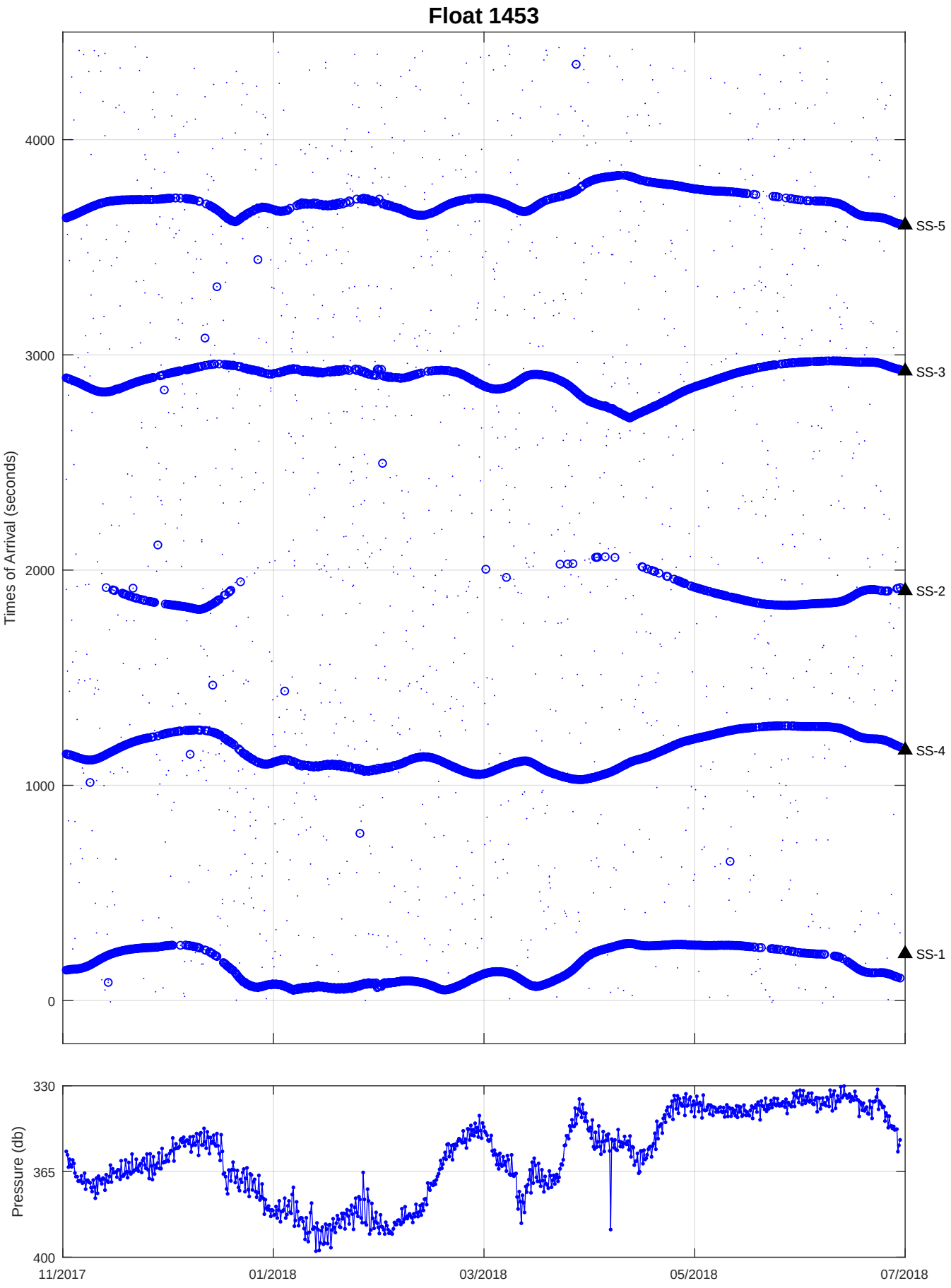

Float 1070
Times of Arrival (seconds)
4000
3000
2000
1000
0
SS-5
SS-3
SS-2
SS-4
SS-1
Pressure (db)
980
995
1010
06/2016
06/2016
07/2016
07/2016
07/2016

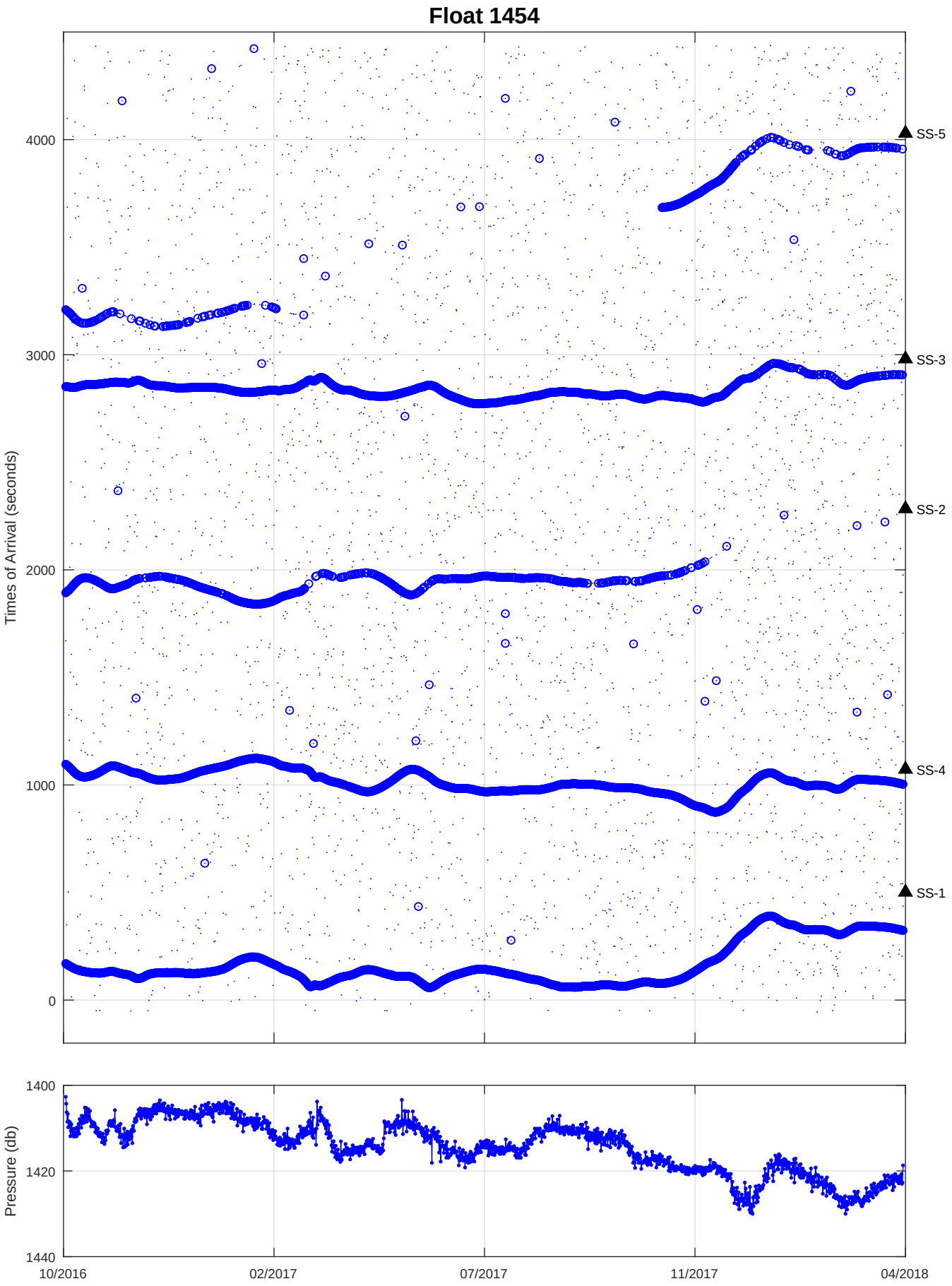

Float 1119
Times of Arrival (seconds)
4000
3000
2000
1000
0
SS-5
SS-3
SS-2
SS-4
SS-1
Pressure (db)
1100
1125
1150
06/2016
07/2016
08/2016
09/2016
10/2016

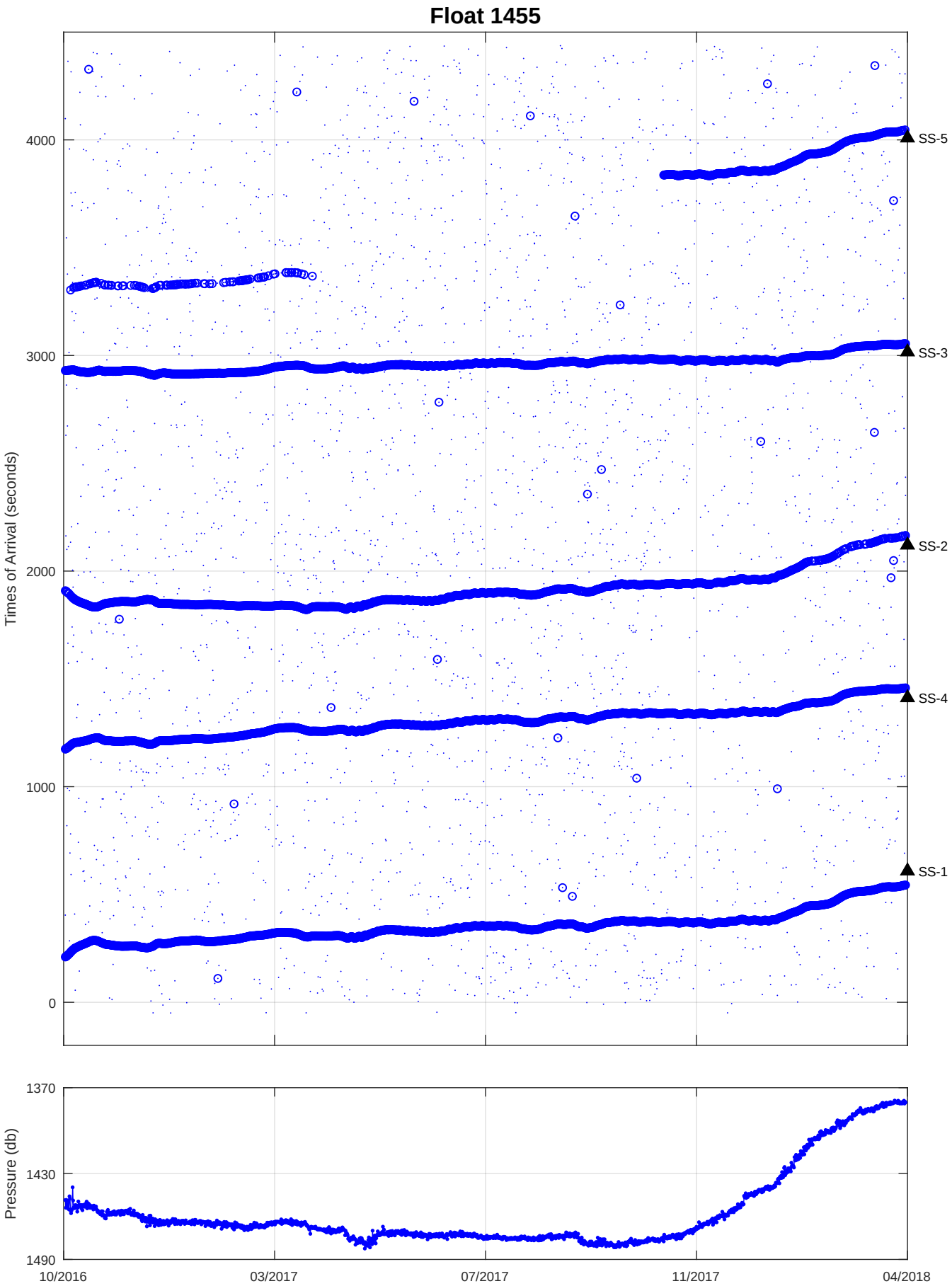

Float 1450
Times of Arrival (seconds)
4000
3000
2000
1000
0
SS-5
SS-3
SS-2
SS-4
SS-1
Pressure (db)
270
340
410
06/2016
10/2016
01/2017
04/2017
08/2017

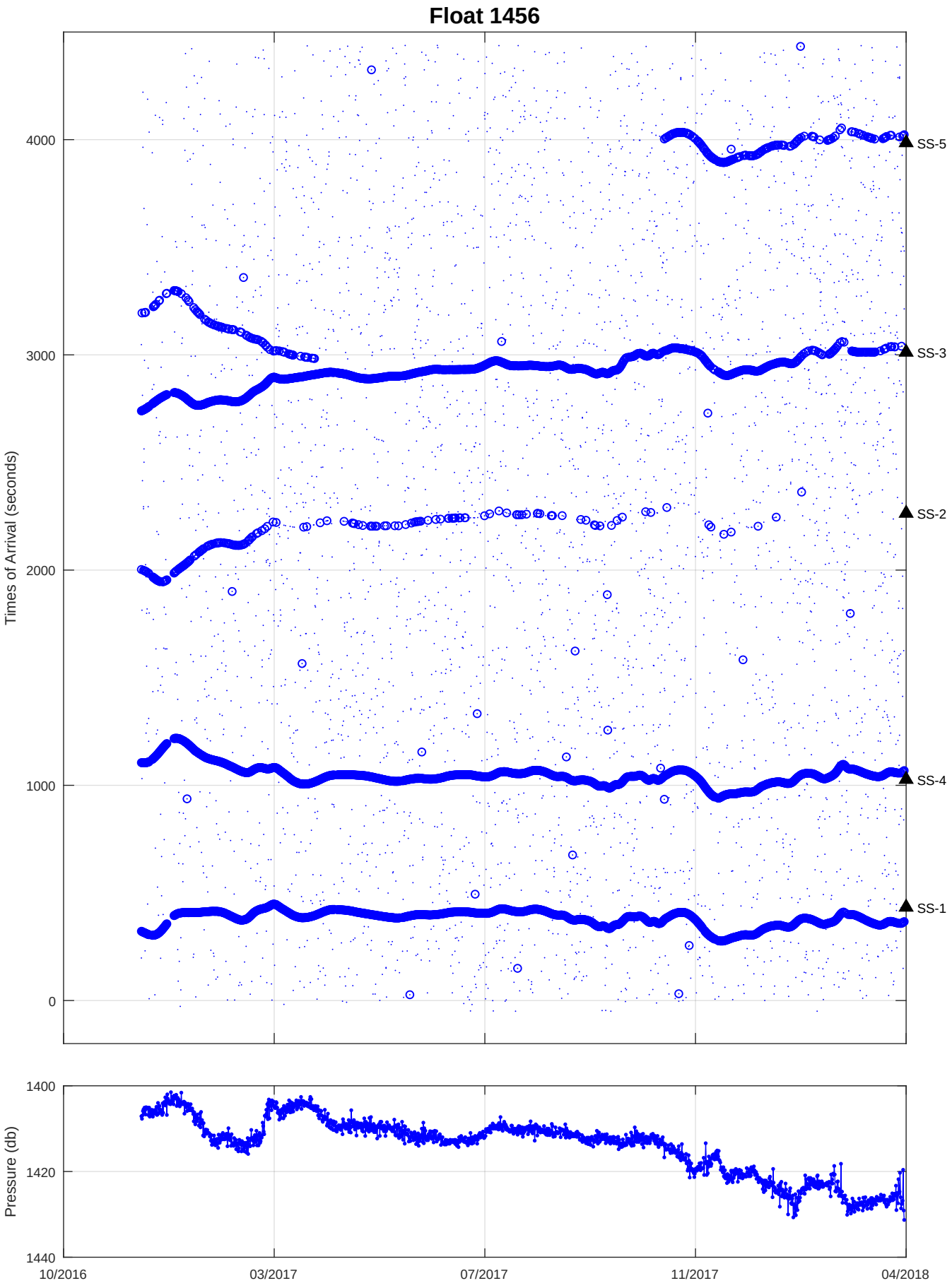

Float 1451
Times of Arrival (seconds)
4000
3000
2000
1000
0
SS-5
SS-3
SS-2
SS-4
SS-1
Pressure (db)
290
320
350
06/2016
07/2016
08/2016
09/2016
10/2016

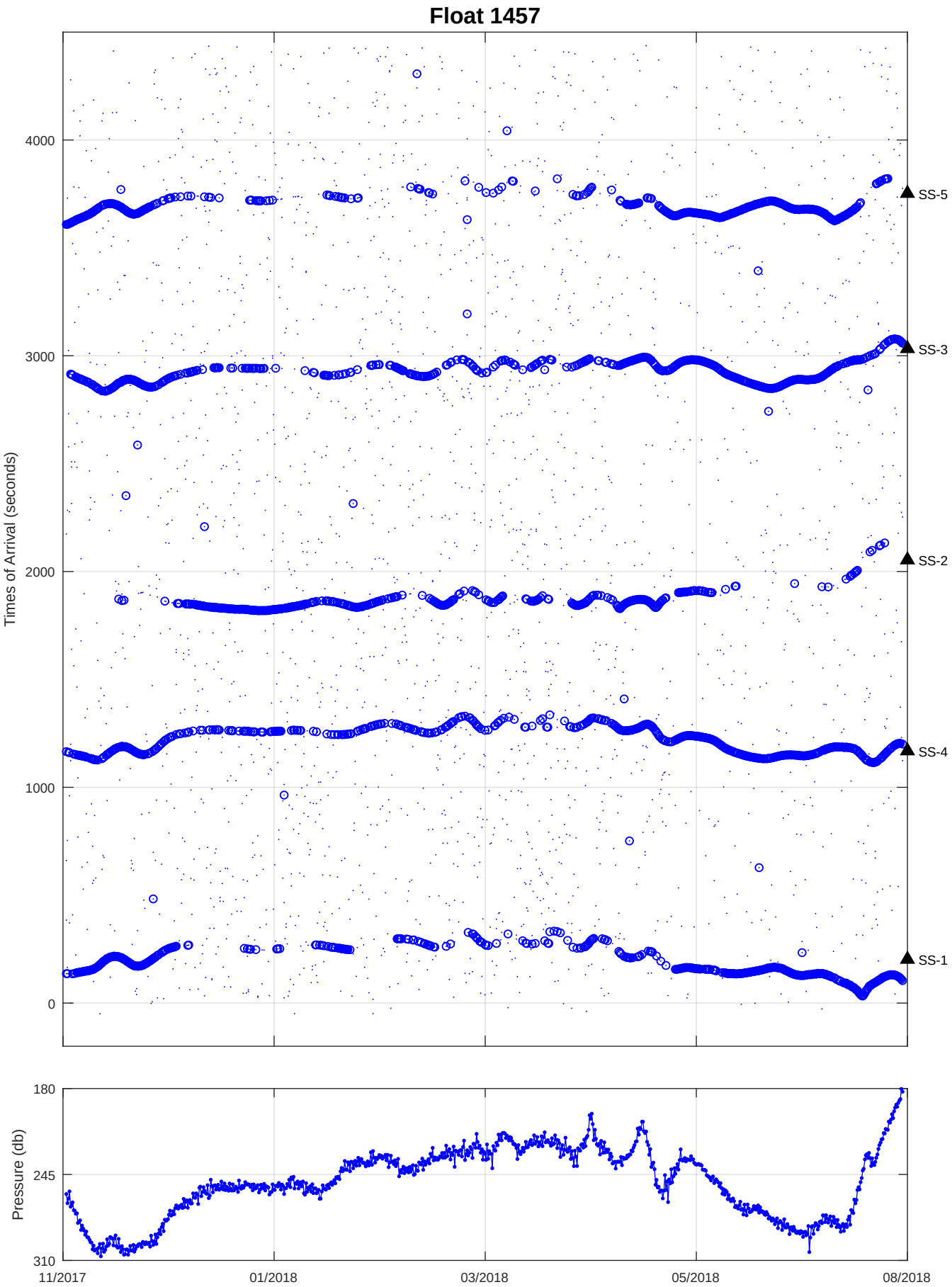

Float 1452
Times of Arrival (seconds)
4000
3000
2000
1000
0
SS-5
SS-3
SS-2
SS-4
SS-1
Pressure (db)
300
325
350
11/2017
12/2017
12/2017
01/2018
02/2018

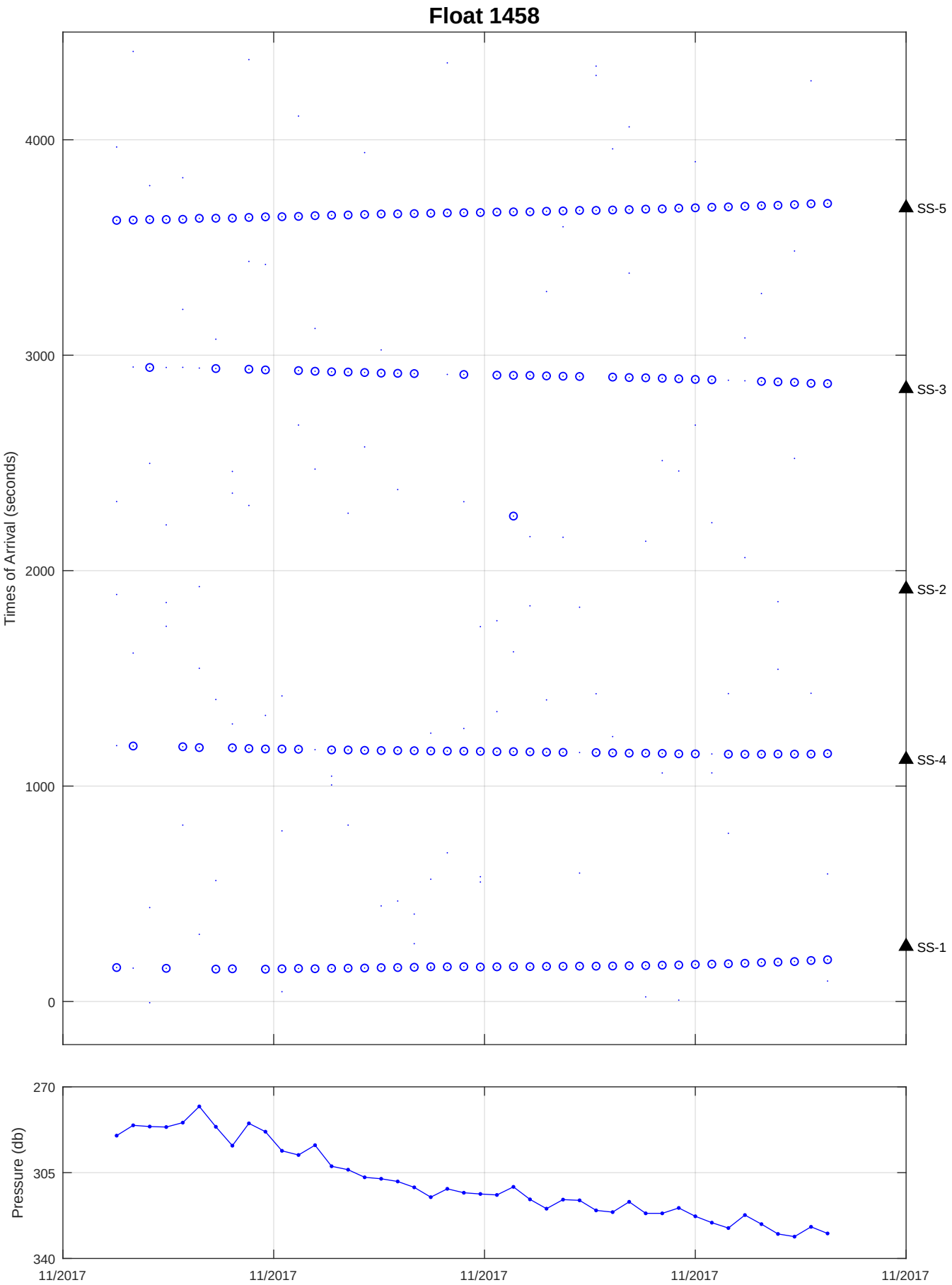

Float 1453
Times of Arrival (seconds)
4000
3000
2000
1000
0
SS-5
SS-3
SS-2
SS-4
SS-1
Pressure (db)
330
365
400
11/2017
01/2018
03/2018
05/2018
07/2018

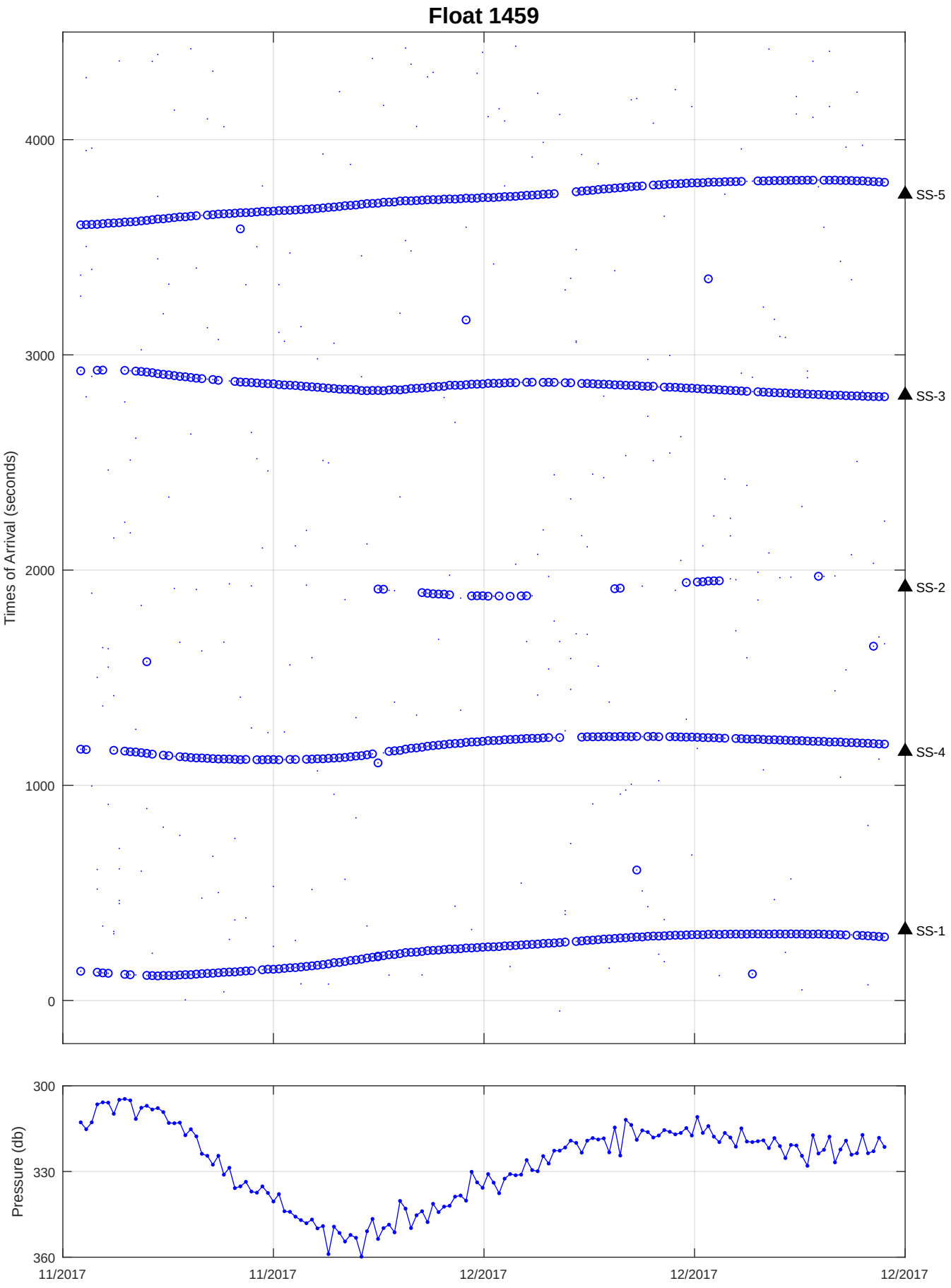

Float 1454
Times of Arrival (seconds)
4000
3000
2000
1000
0
SS-5
SS-3
SS-2
SS-4
SS-1
Pressure (db)
1400
1420
1440
10/2016
02/2017
07/2017
11/2017
04/2018

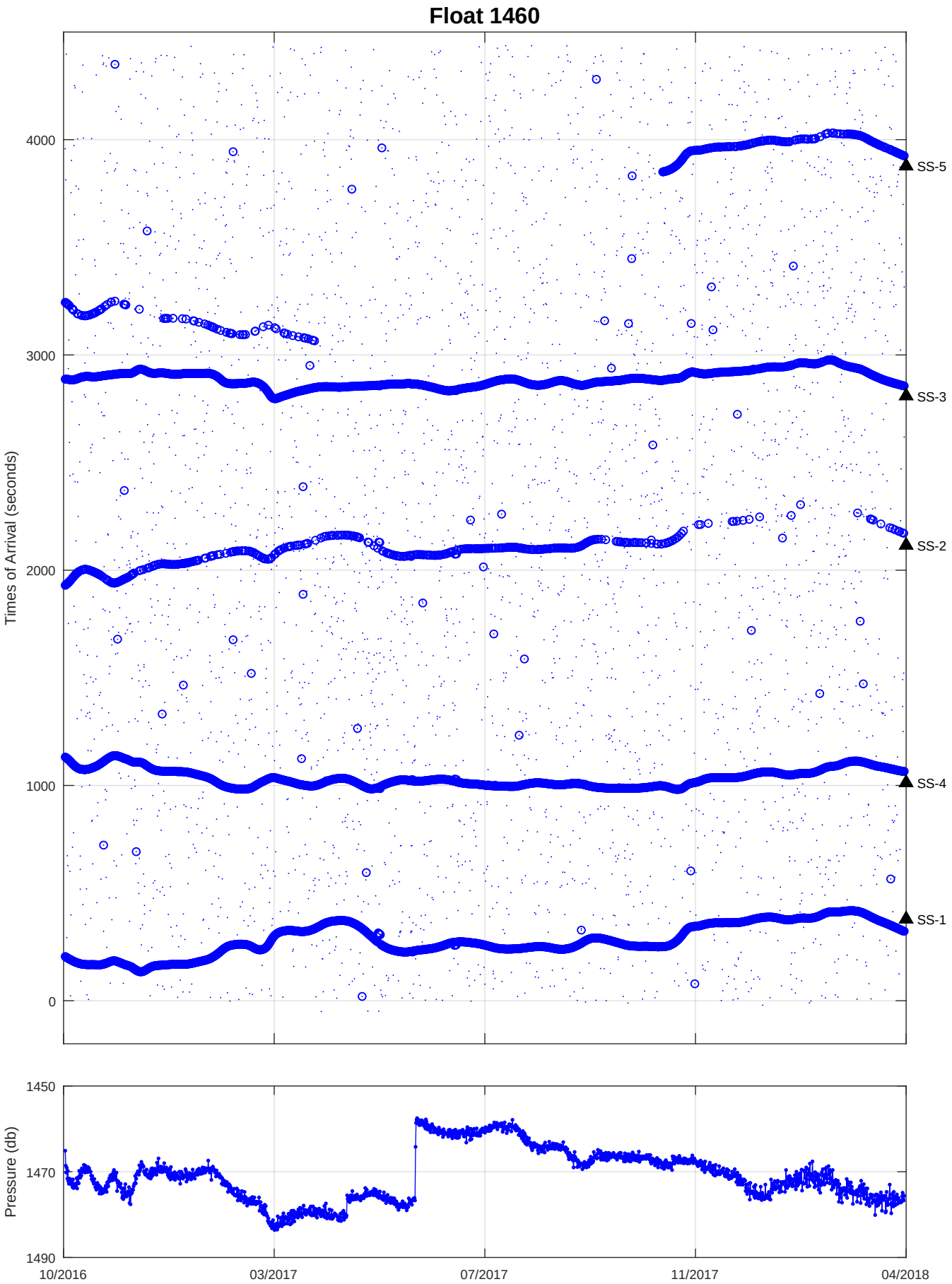

Float 1455
Times of Arrival (seconds)
4000
3000
2000
1000
0
SS-5
SS-3
SS-2
SS-4
SS-1
Pressure (db)
1370
1430
1490
10/2016
03/2017
07/2017
11/2017
04/2018

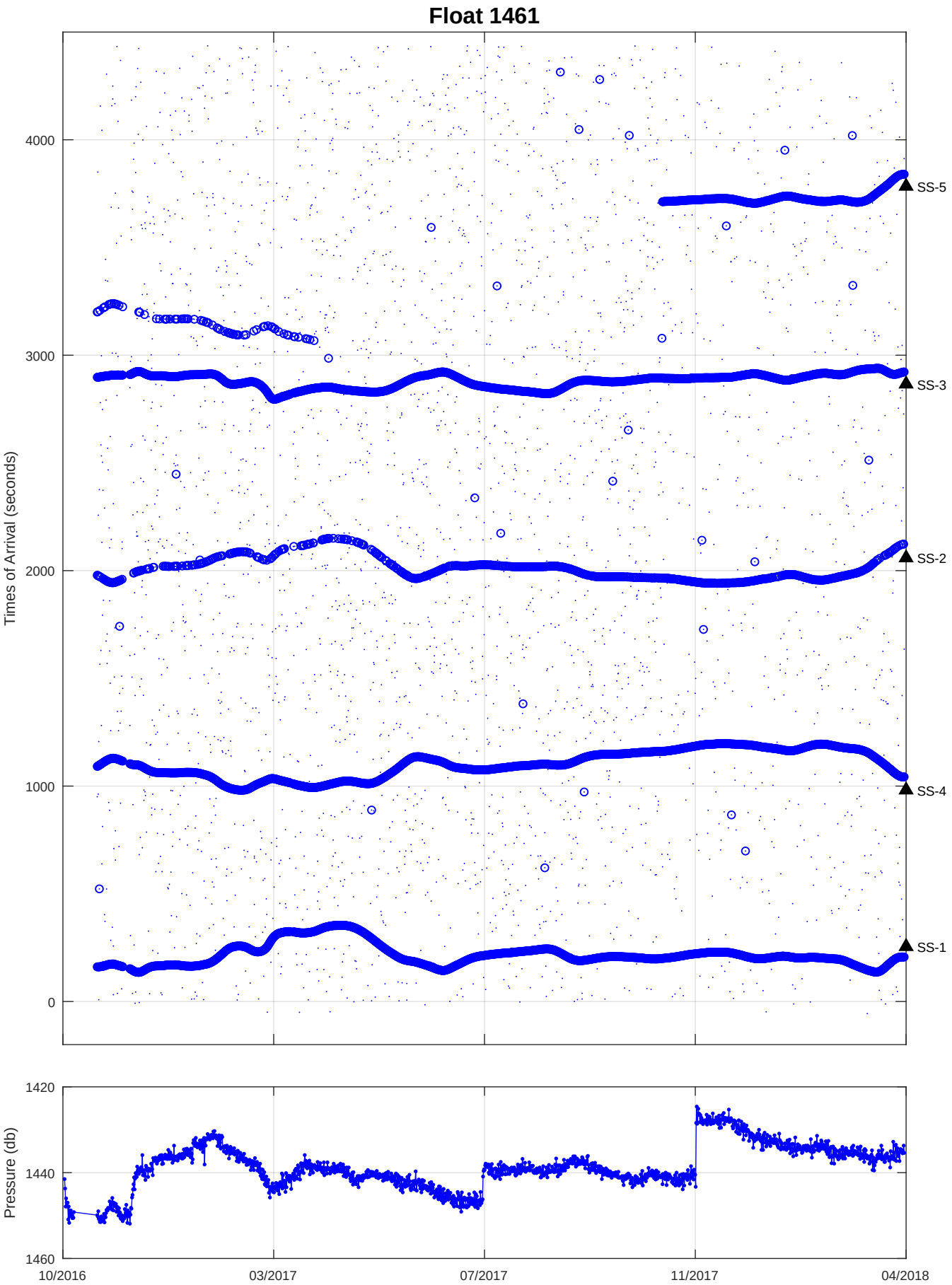

Float 1456
Times of Arrival (seconds)
4000
3000
2000
1000
0
SS-5
SS-3
SS-2
SS-4
SS-1
Pressure (db)
1400
1420
1440
10/2016
03/2017
07/2017
11/2017
04/2018

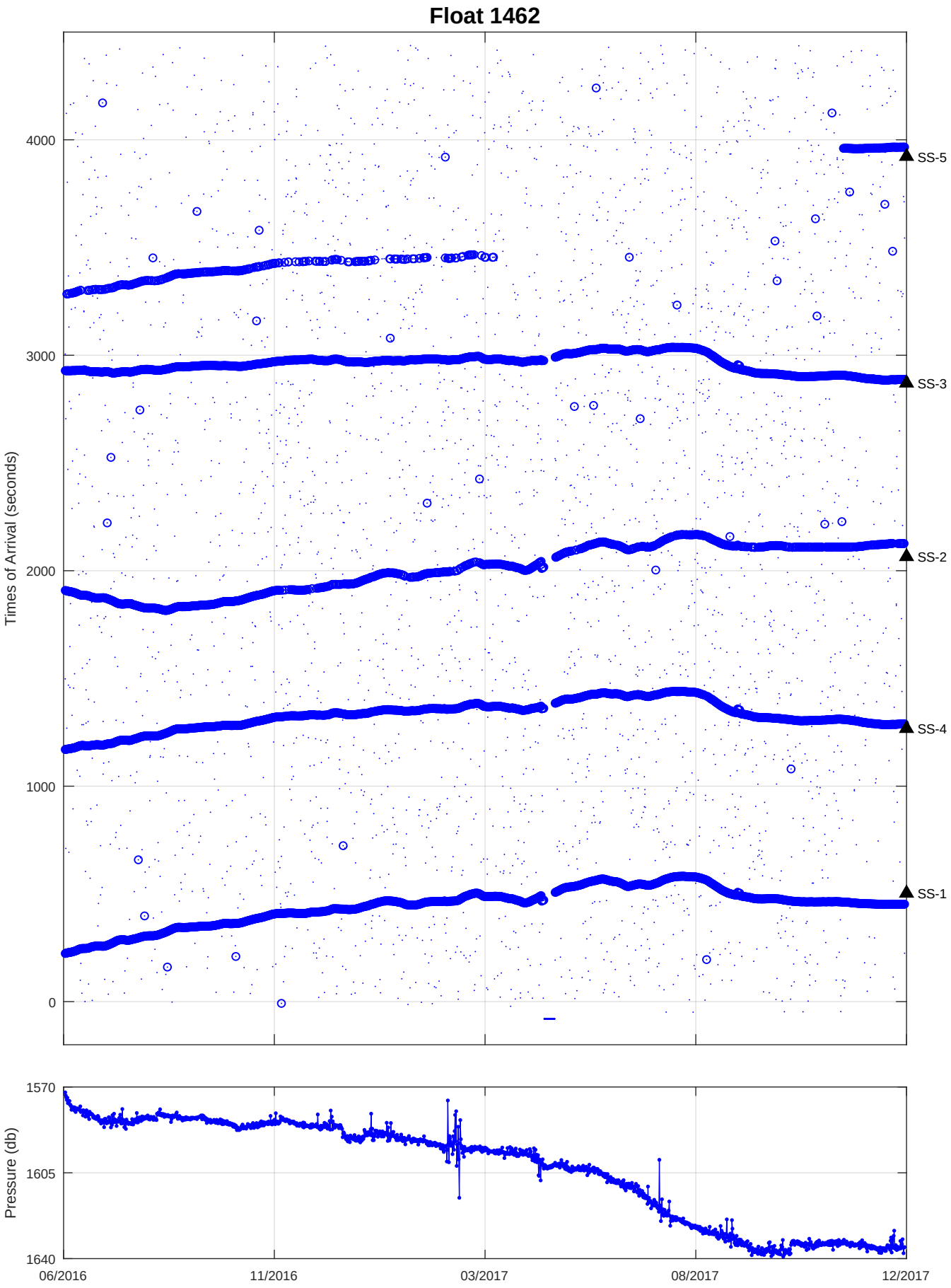

Float 1457
Times of Arrival (seconds)
4000
3000
2000
1000
0
SS-5
SS-3
SS-2
SS-4
SS-1
Pressure (db)
180
245
310
11/2017
01/2018
03/2018
05/2018
08/2018

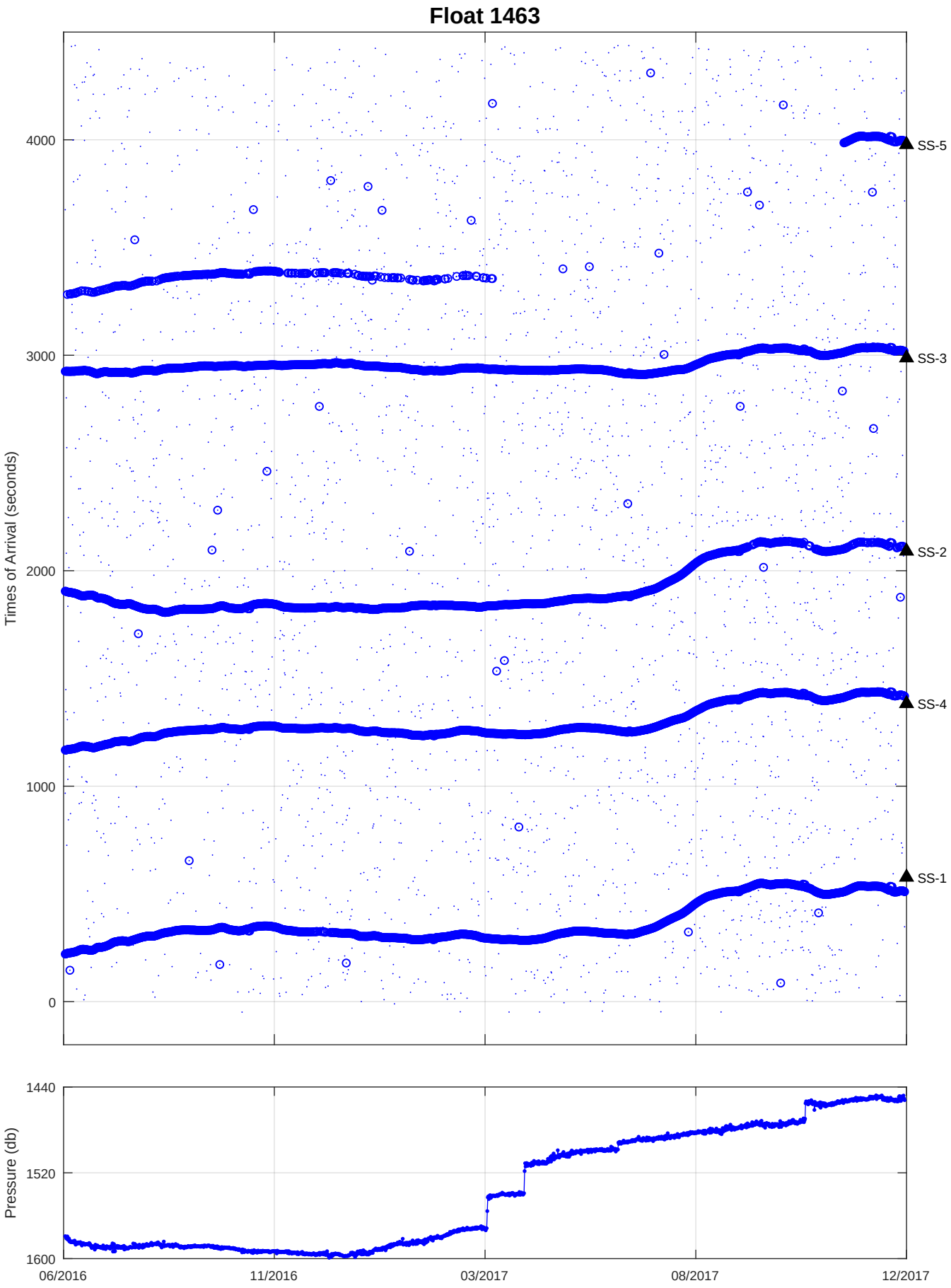

Float 1458
Times of Arrival (seconds)
4000
3000
2000
1000
0
SS-5
SS-3
SS-2
SS-4
SS-1
Pressure (db)
270
305
340
11/2017
11/2017
11/2017
11/2017
11/2017

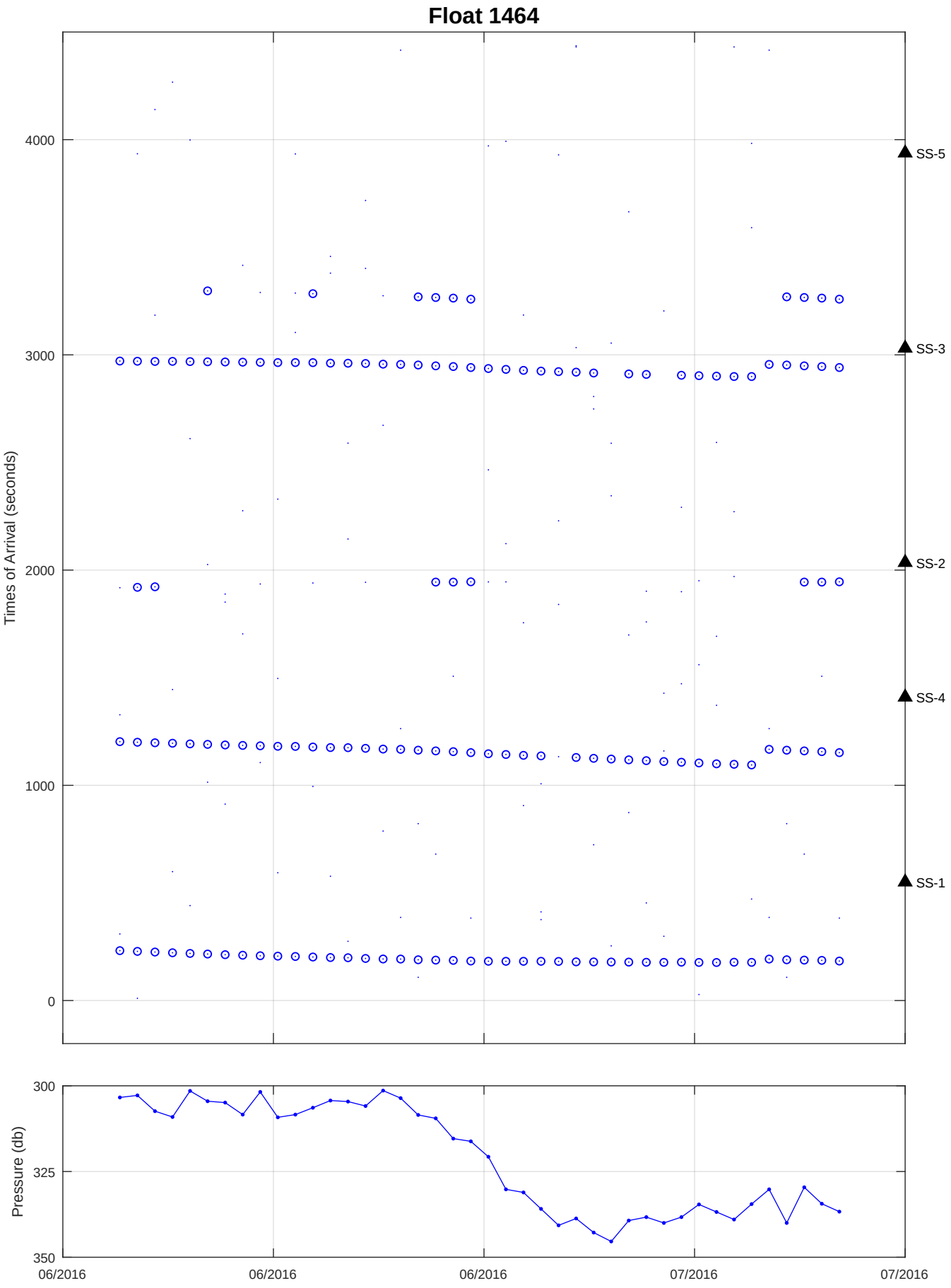

Float 1459
Times of Arrival (seconds)
4000
3000
2000
1000
0
SS-5
SS-3
SS-2
SS-4
SS-1
Pressure (db)
300
330
360
11/2017
11/2017
12/2017
12/2017
12/2017

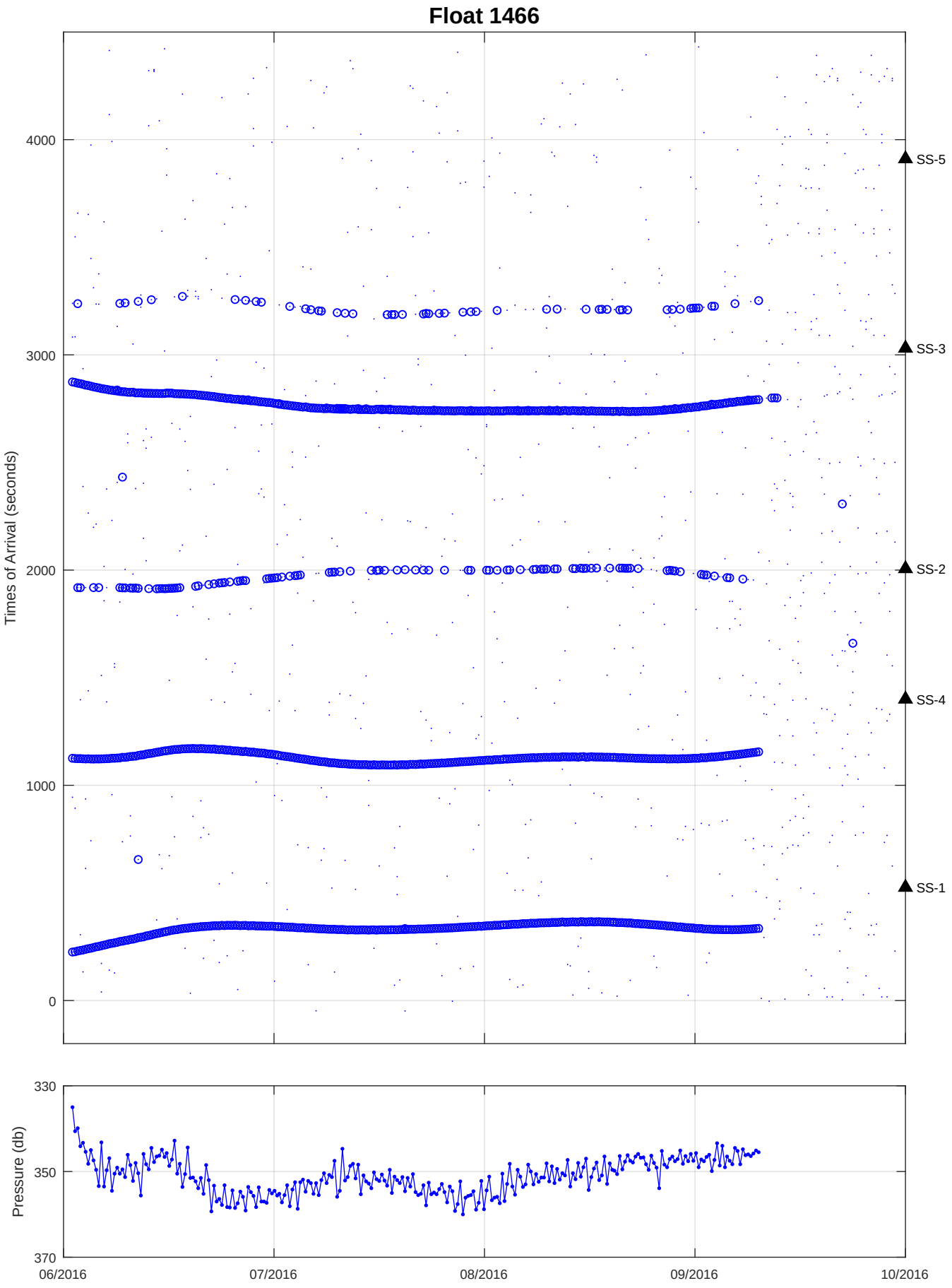

Float 1460
Times of Arrival (seconds)
4000
3000
2000
1000
0
SS-5
SS-3
SS-2
SS-4
SS-1
Pressure (db)
1450
1470
1490
10/2016
03/2017
07/2017
11/2017
04/2018

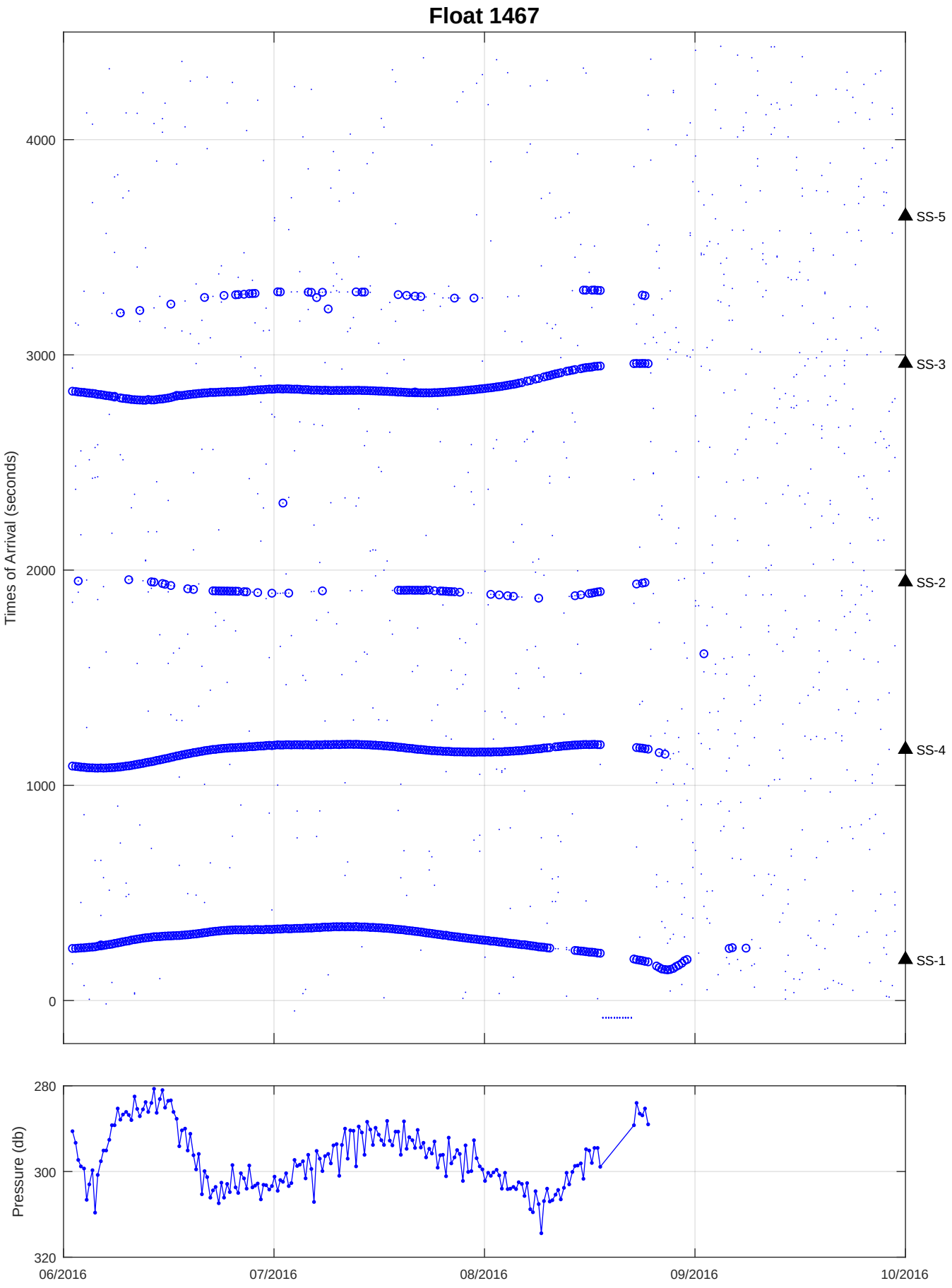

Float 1461
Times of Arrival (seconds)
4000
3000
2000
1000
0
SS-5
SS-3
SS-2
SS-4
SS-1
Pressure (db)
1420
1440
1460
10/2016
03/2017
07/2017
11/2017
04/2018

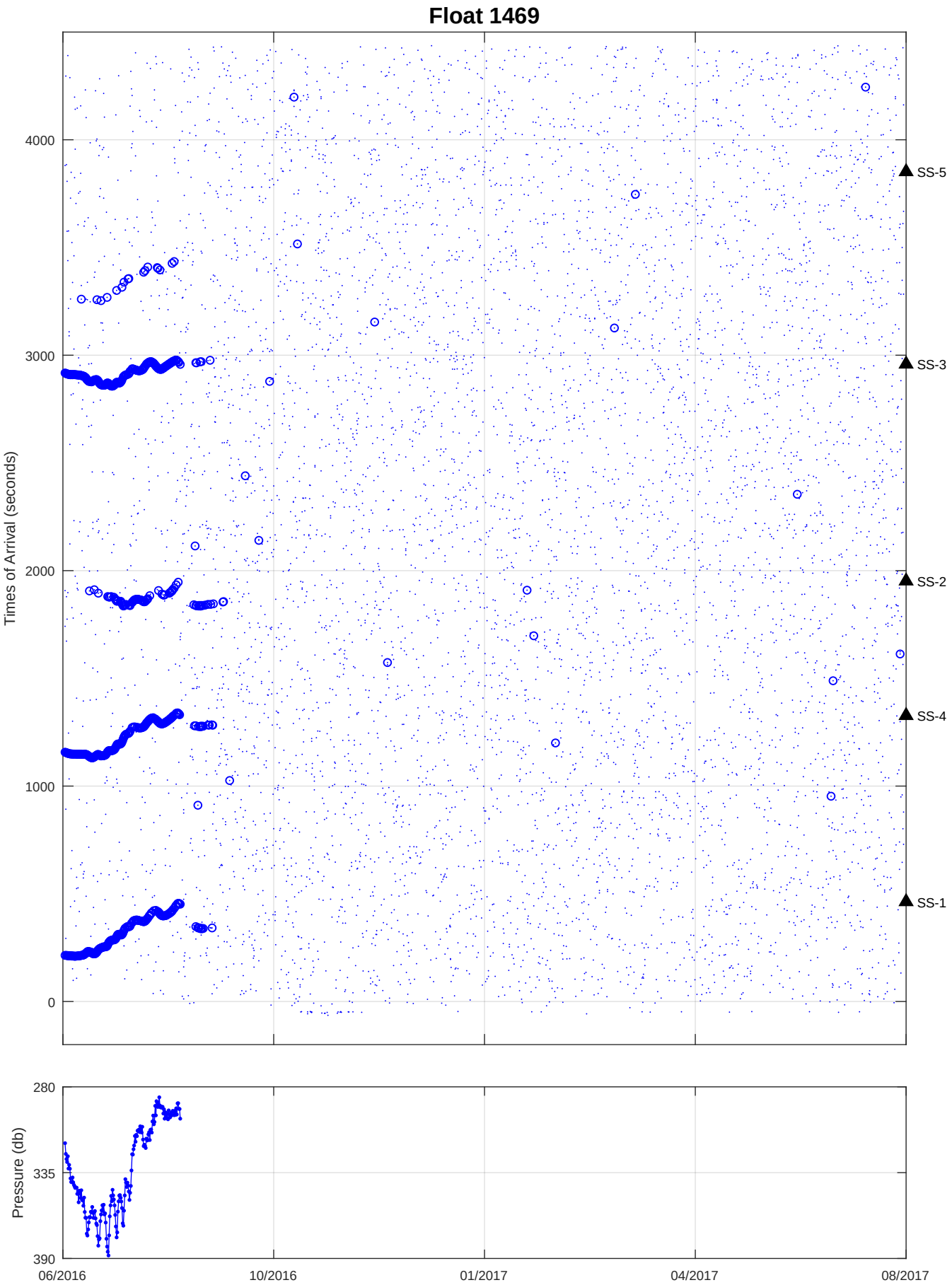

Float 1462
Times of Arrival (seconds)
4000
3000
2000
1000
0
SS-5
SS-3
SS-2
SS-4
SS-1
Pressure (db)
1570
1605
1640
06/2016
11/2016
03/2017
08/2017
12/2017

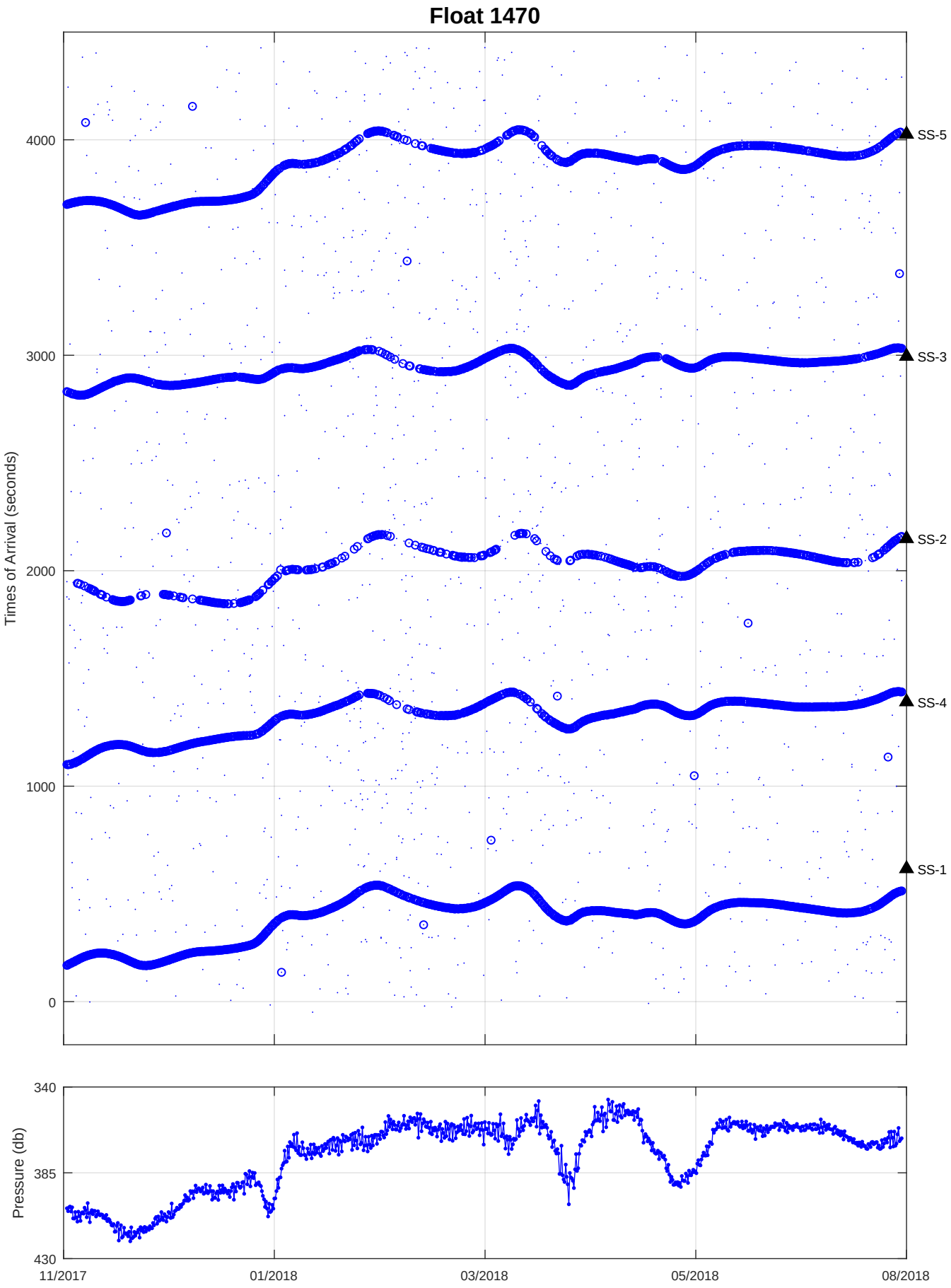

Float 1463
Times of Arrival (seconds)
4000
3000
2000
1000
0
SS-5
SS-3
SS-2
SS-4
SS-1
Pressure (db)
1440
1520
1600
06/2016
11/2016
03/2017
08/2017
12/2017

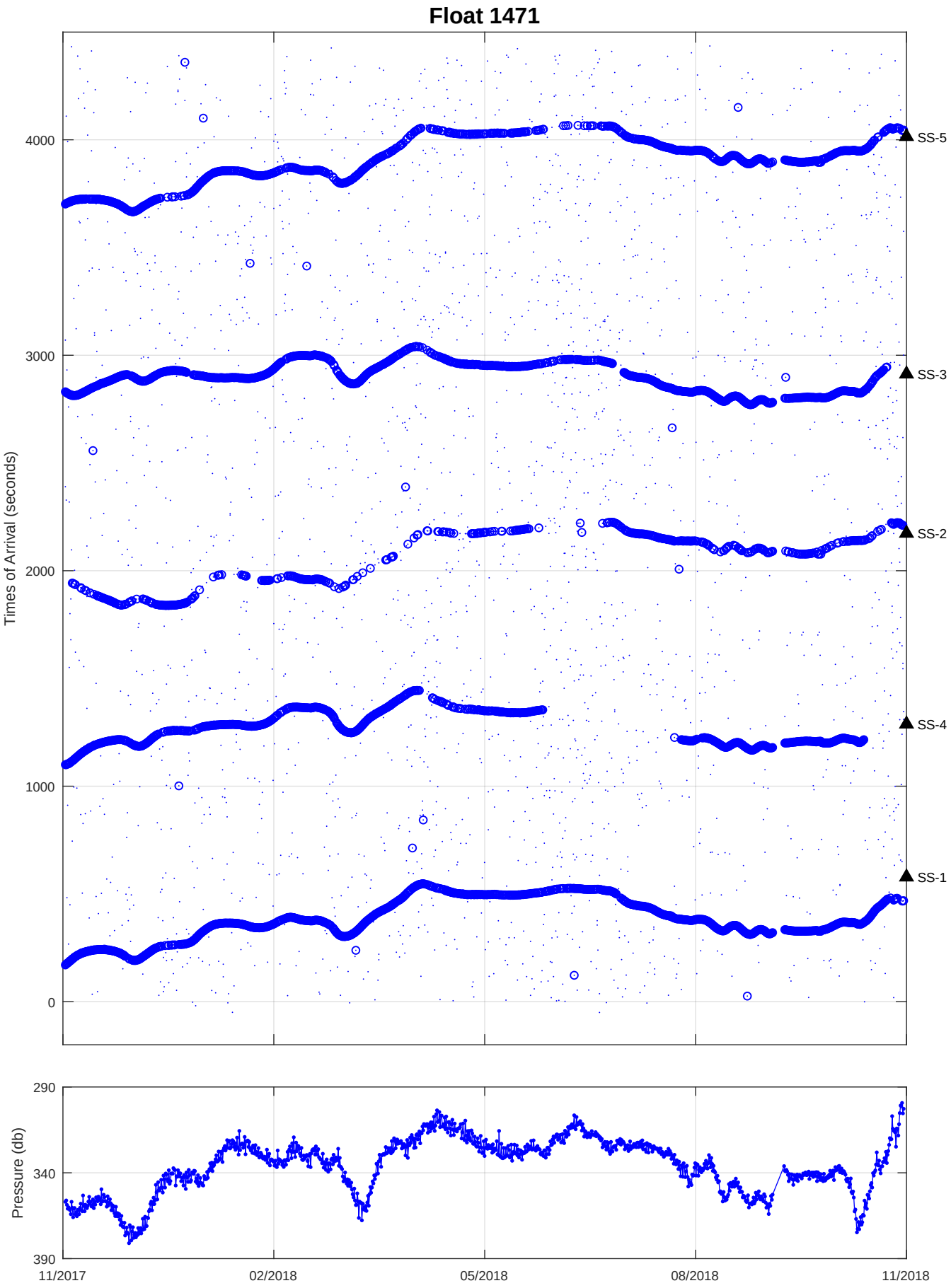

Float 1464
Times of Arrival (seconds)
4000
3000
2000
1000
0
SS-5
SS-3
SS-2
SS-4
SS-1
Pressure (db)
300
325
350
06/2016
06/2016
06/2016
07/2016
07/2016

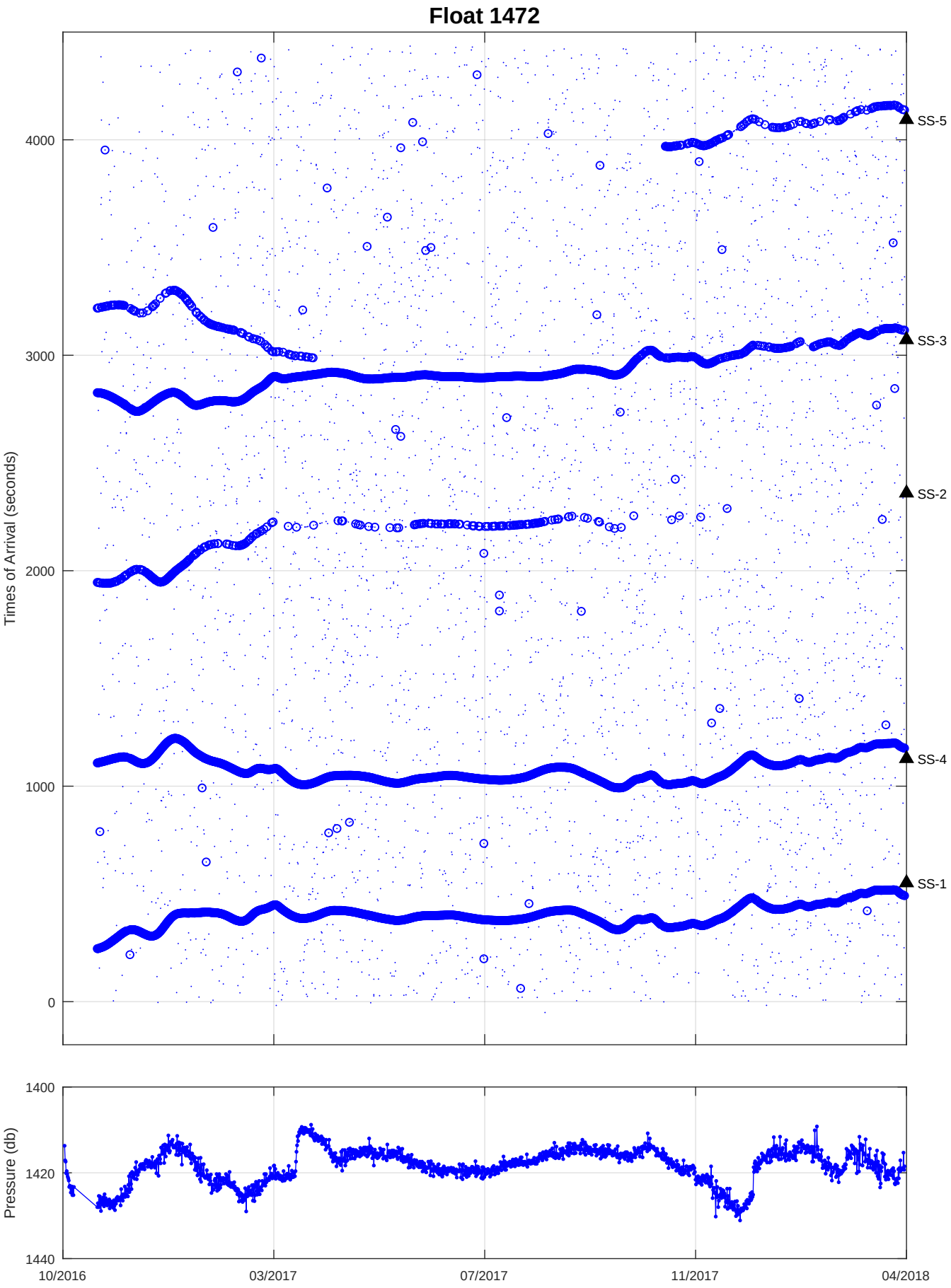

Float 1466
Times of Arrival (seconds)
4000
3000
2000
1000
0
SS-5
SS-3
SS-2
SS-4
SS-1
Pressure (db)
330
350
370
06/2016
07/2016
08/2016
09/2016
10/2016

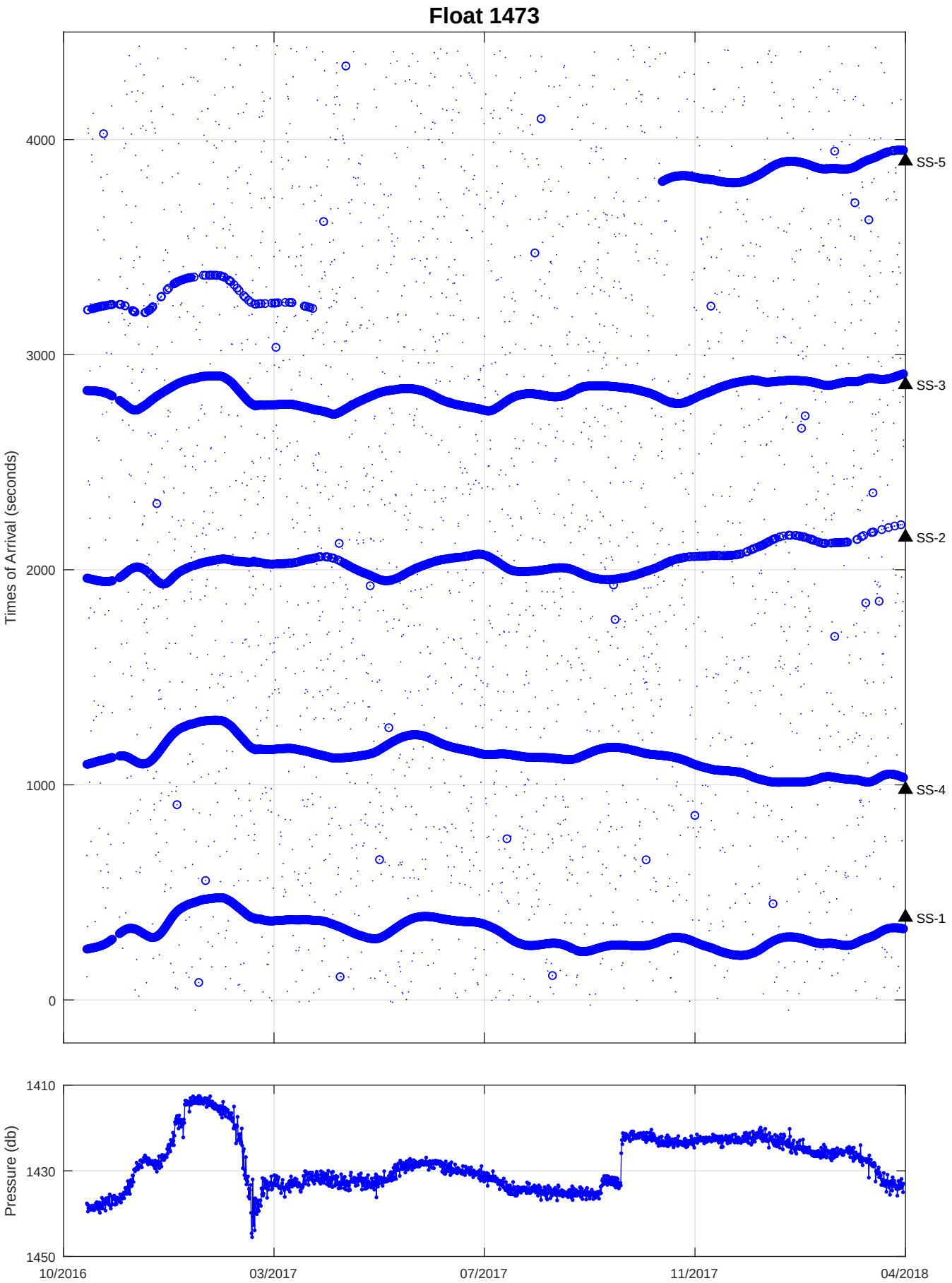

Float 1467
Times of Arrival (seconds)
4000
3000
2000
1000
0
SS-5
SS-3
SS-2
SS-4
SS-1
Pressure (db)
280
300
320
06/2016
07/2016
08/2016
09/2016
10/2016

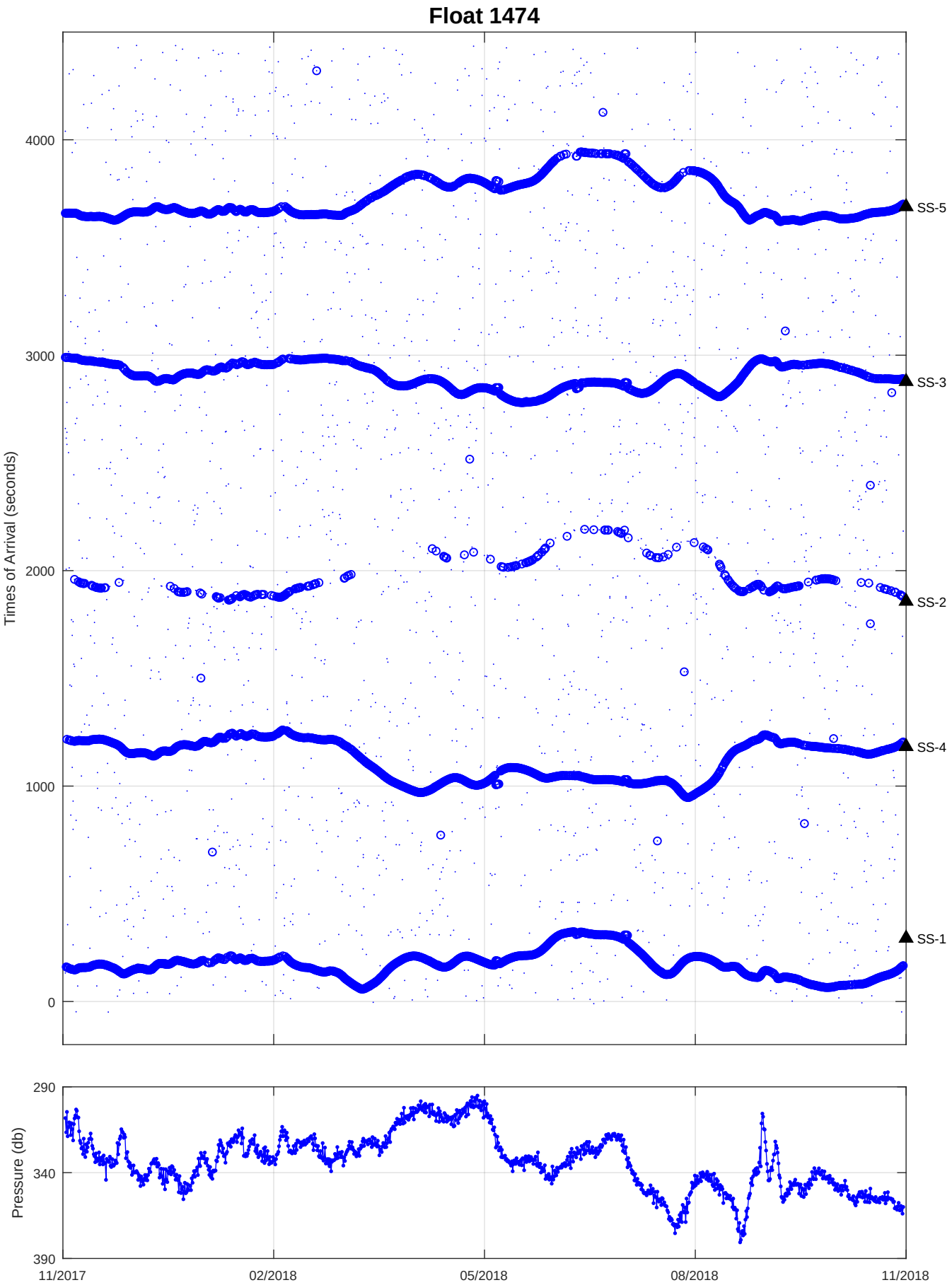

Float 1469
Times of Arrival (seconds)
4000
3000
2000
1000
0
SS-5
SS-3
SS-2
SS-4
SS-1
Pressure (db)
280
335
390
06/2016
10/2016
01/2017
04/2017
08/2017

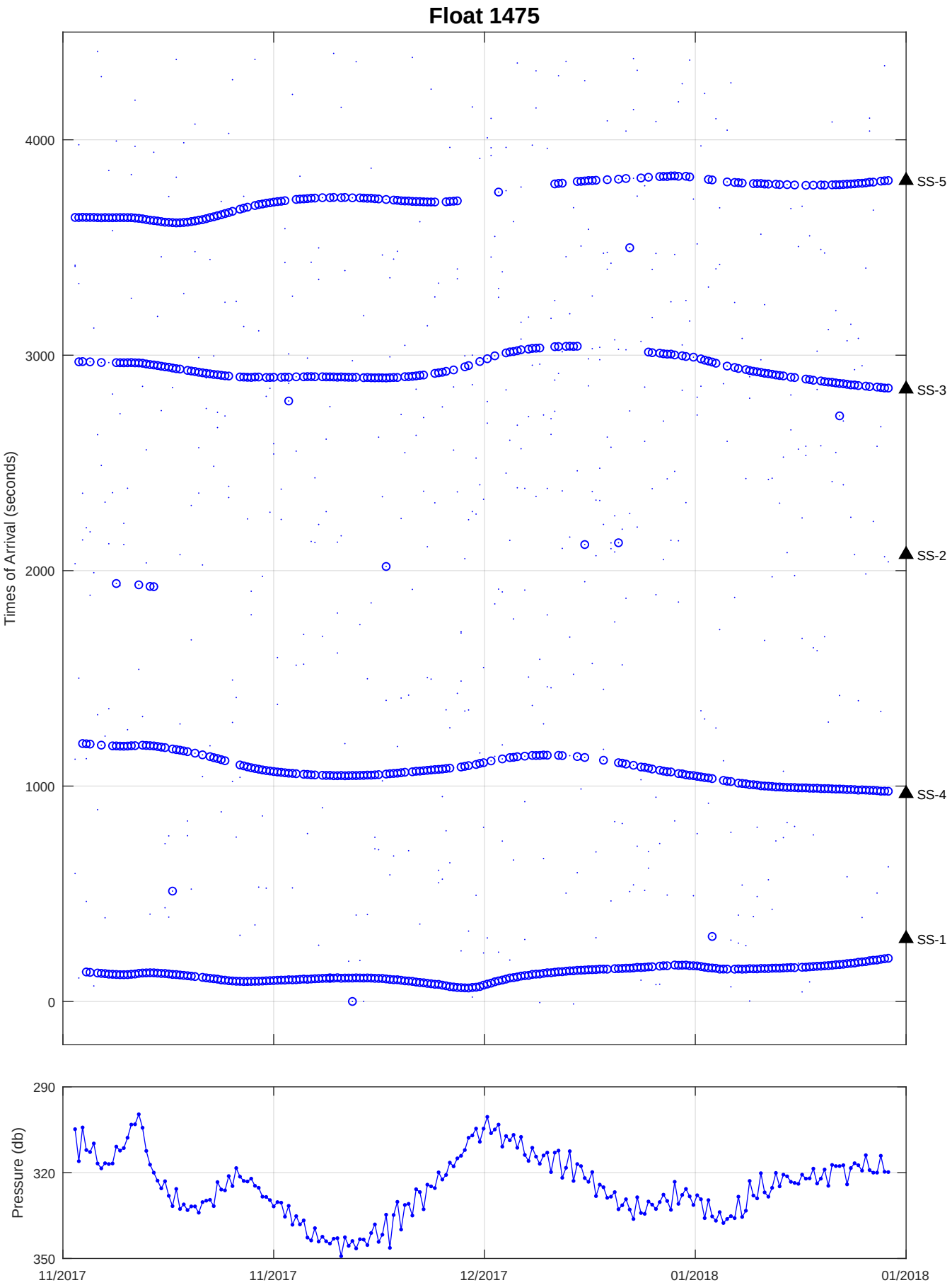

Float 1470
Times of Arrival (seconds)
4000
3000
2000
1000
0
SS-5
SS-3
SS-2
SS-4
SS-1
Pressure (db)
340
385
430
11/2017
01/2018
03/2018
05/2018
08/2018

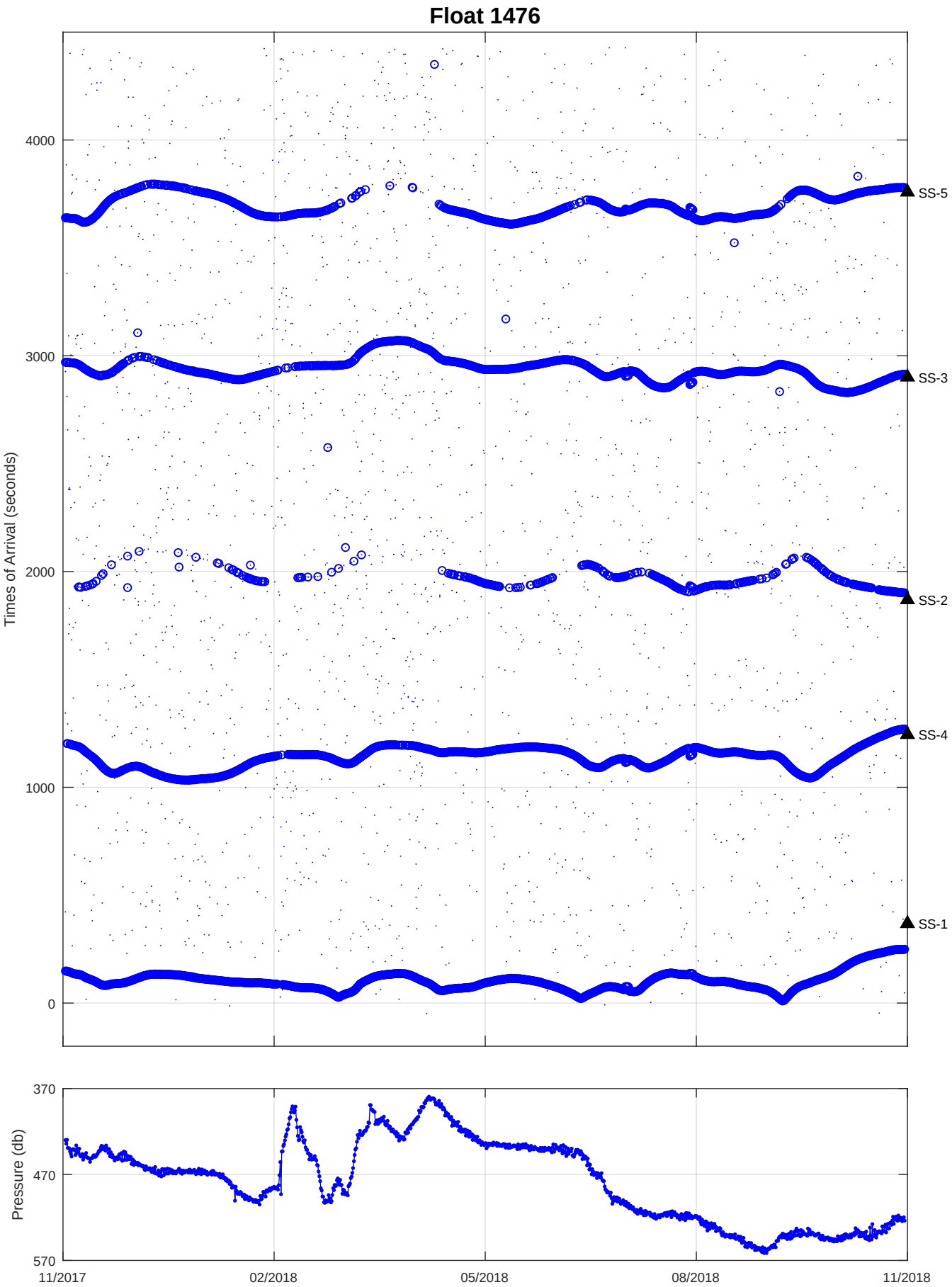

Float 1471
Times of Arrival (seconds)
4000
3000
2000
1000
0
SS-5
SS-3
SS-2
SS-4
SS-1
Pressure (db)
290
340
390
11/2017
02/2018
05/2018
08/2018
11/2018

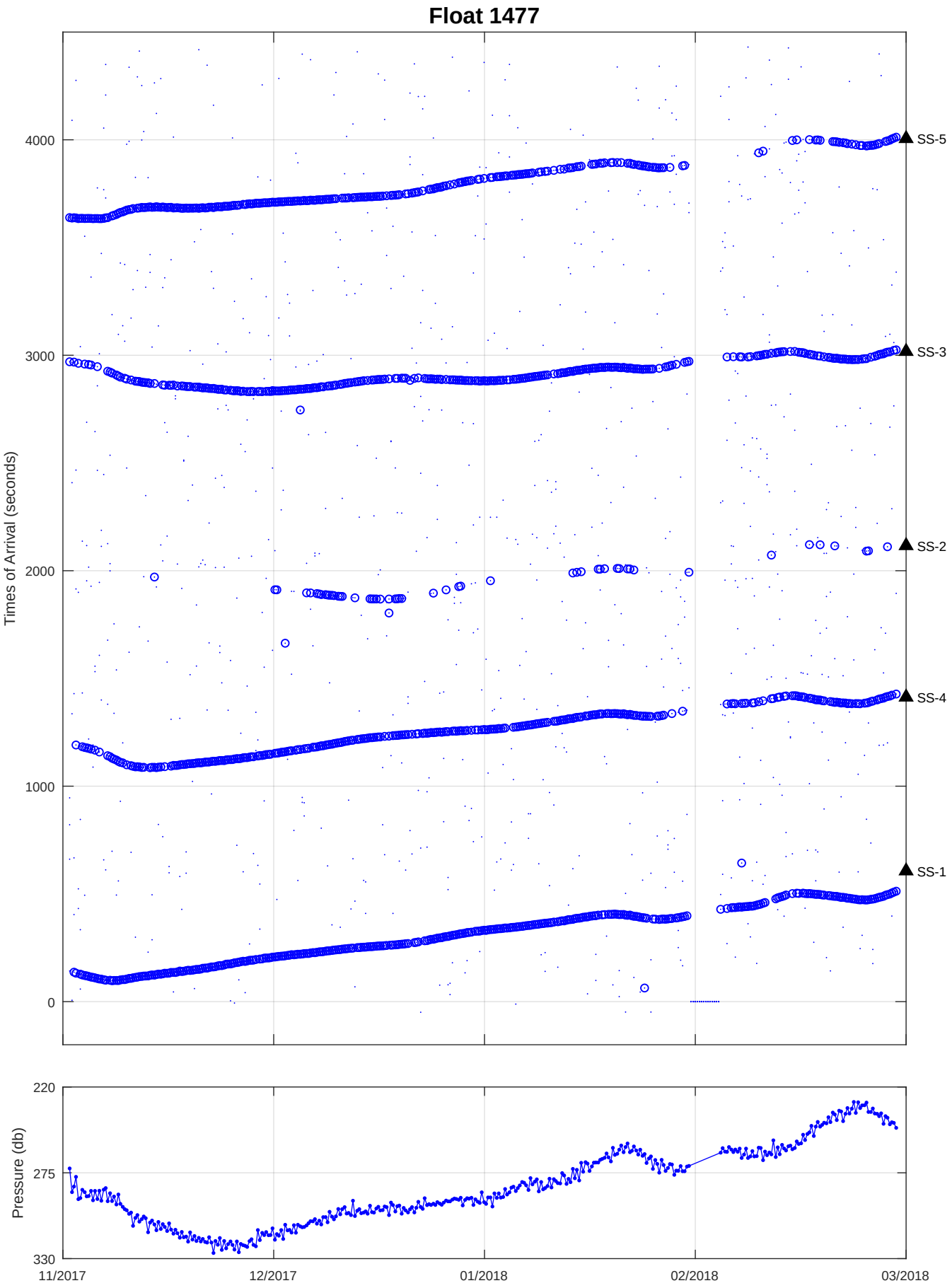

Float 1472
Times of Arrival (seconds)
4000
3000
2000
1000
0
SS-5
SS-3
SS-2
SS-4
SS-1
Pressure (db)
1400
1420
1440
10/2016
03/2017
07/2017
11/2017
04/2018


Float 1473
Times of Arrival (seconds)
4000
3000
2000
1000
0
SS-5
SS-3
SS-2
SS-4
SS-1
Pressure (db)
1410
1430
1450
10/2016
03/2017
07/2017
11/2017
04/2018

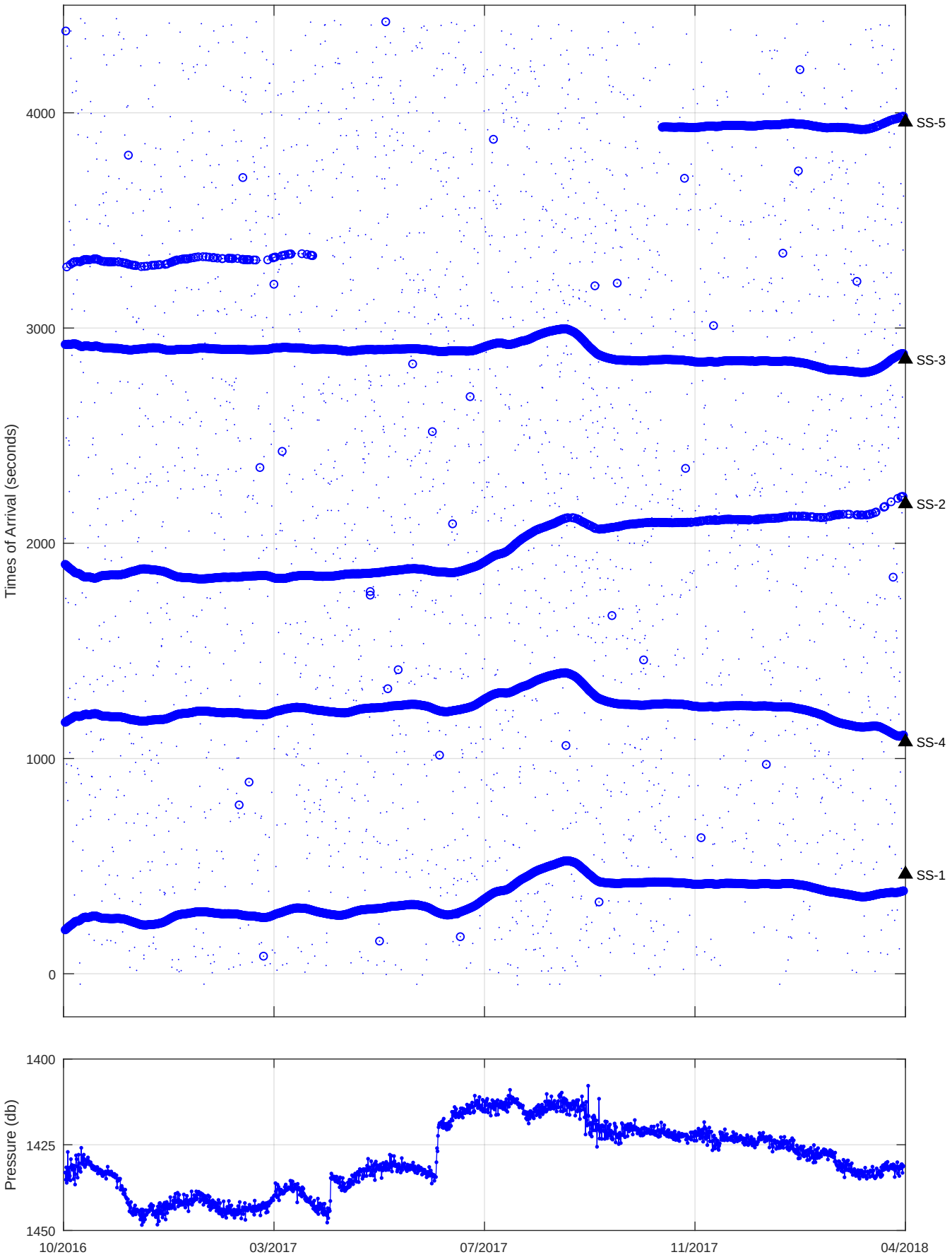

Float 1474
Times of Arrival (seconds)
4000
3000
2000
1000
0
SS-5
SS-3
SS-2
SS-4
SS-1
Pressure (db)
290
340
390
11/2017
02/2018
05/2018
08/2018
11/2018

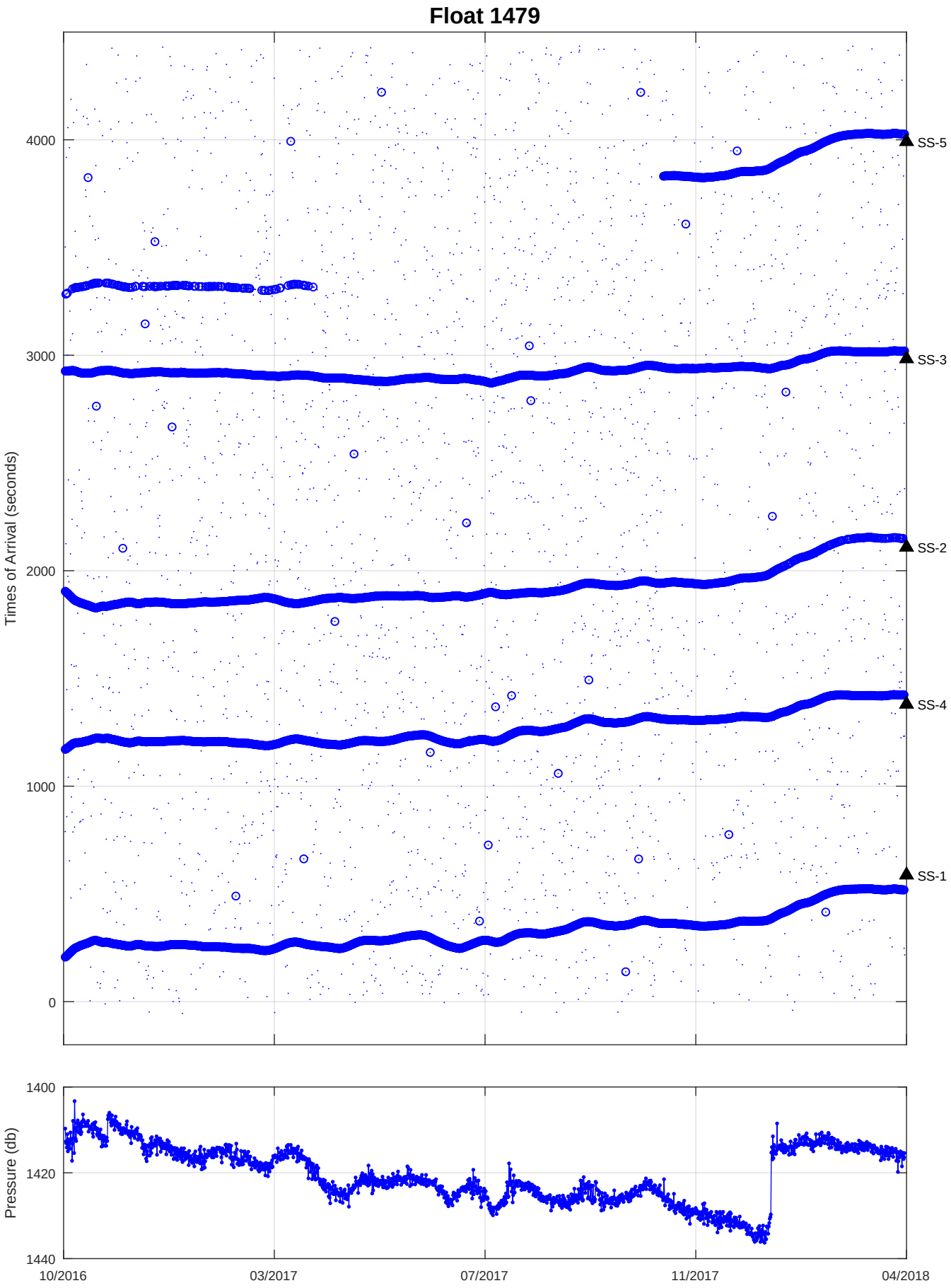

Float 1475
Times of Arrival (seconds)
4000
3000
2000
1000
0
SS-5
SS-3
SS-2
SS-4
SS-1
Pressure (db)
290
320
350
11/2017
11/2017
12/2017
01/2018
01/2018

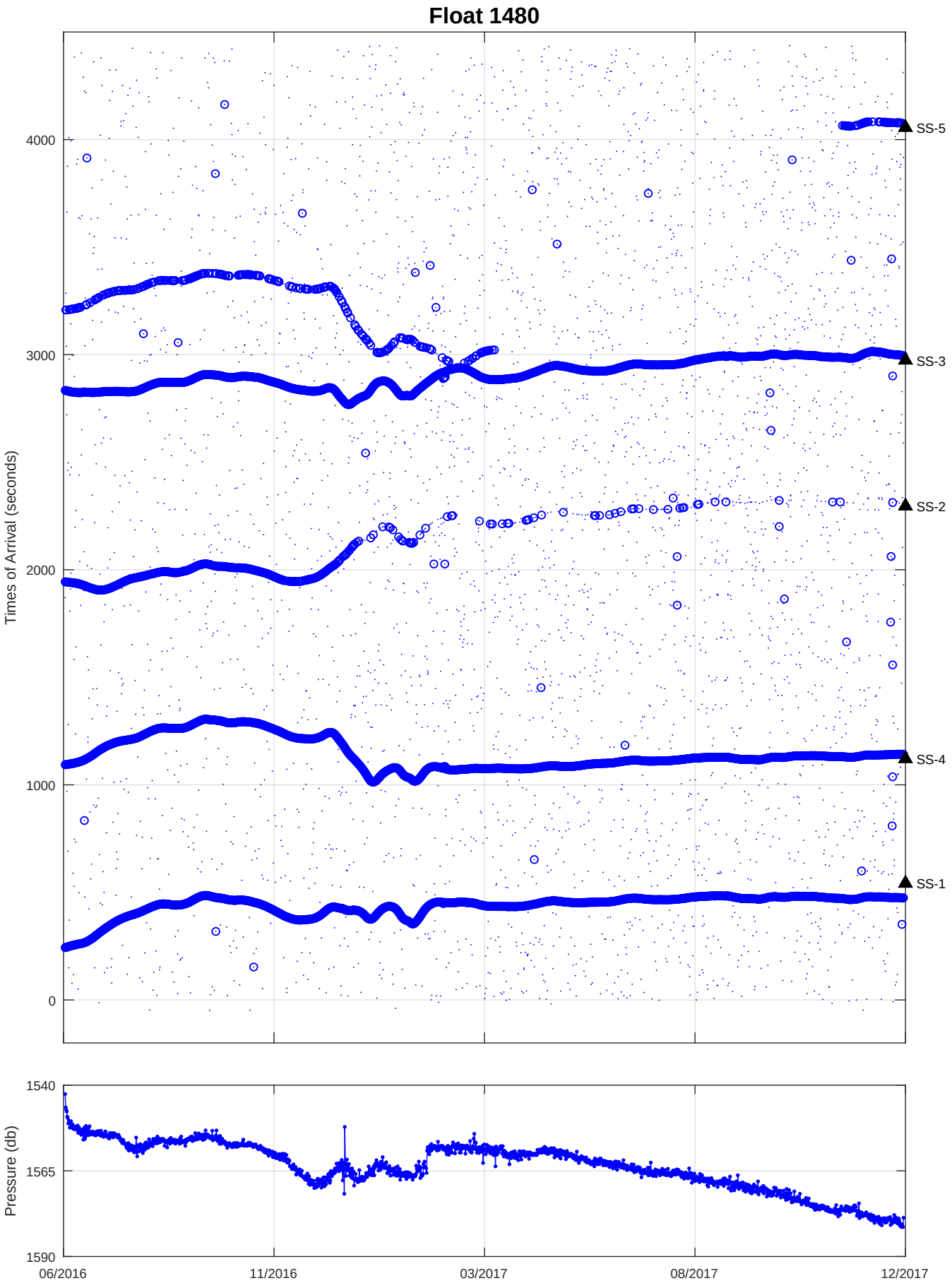

Float 1476
Times of Arrival (seconds)
4000
3000
2000
1000
0
SS-5
SS-3
SS-2
SS-4
SS-1
Pressure (db)
370
470
570
11/2017
02/2018
05/2018
08/2018
11/2018

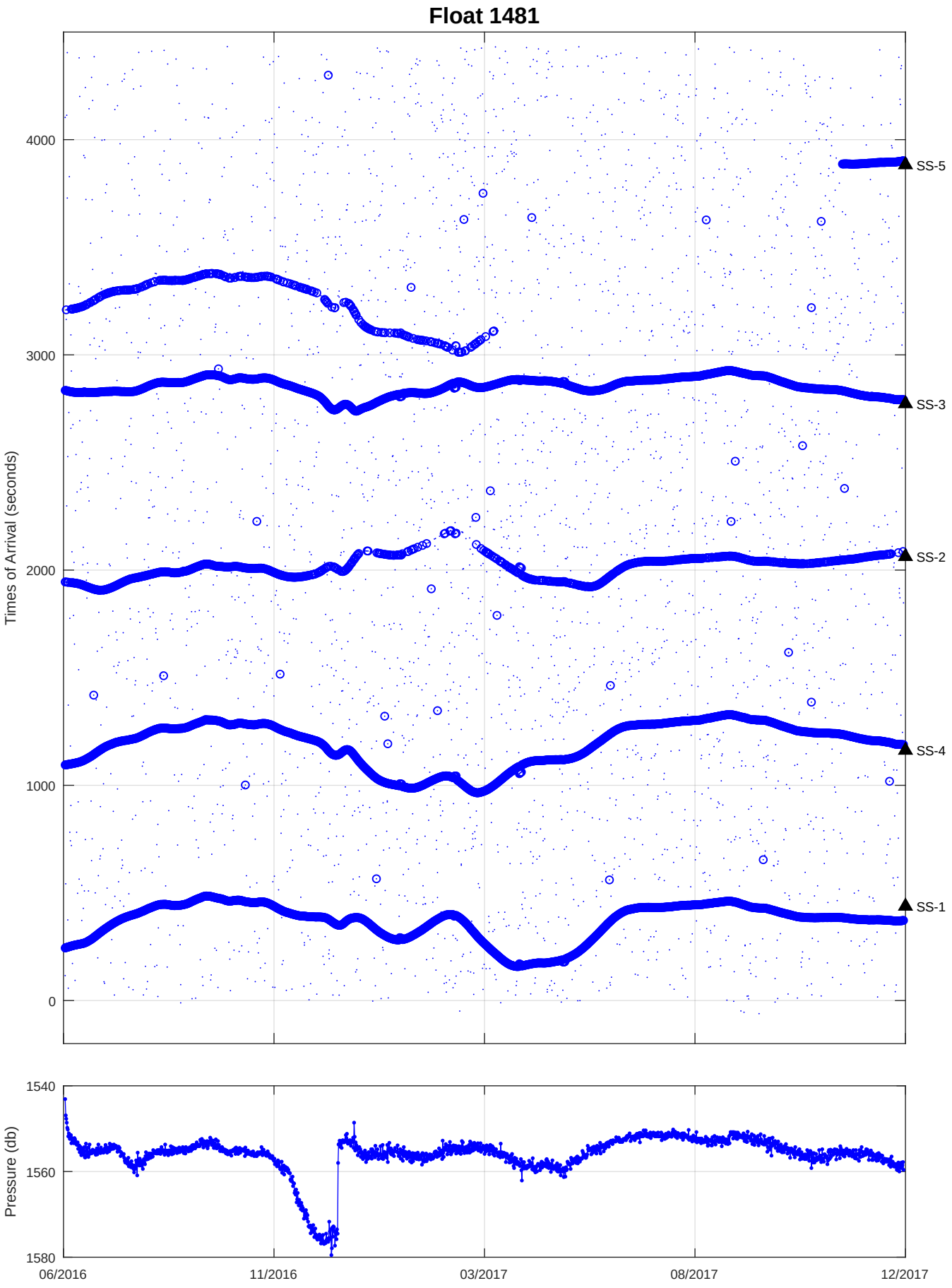

Float 1477
Times of Arrival (seconds)
4000
3000
2000
1000
0
SS-5
SS-3
SS-2
SS-4
SS-1
Pressure (db)
220
275
330
11/2017
12/2017
01/2018
02/2018
03/2018

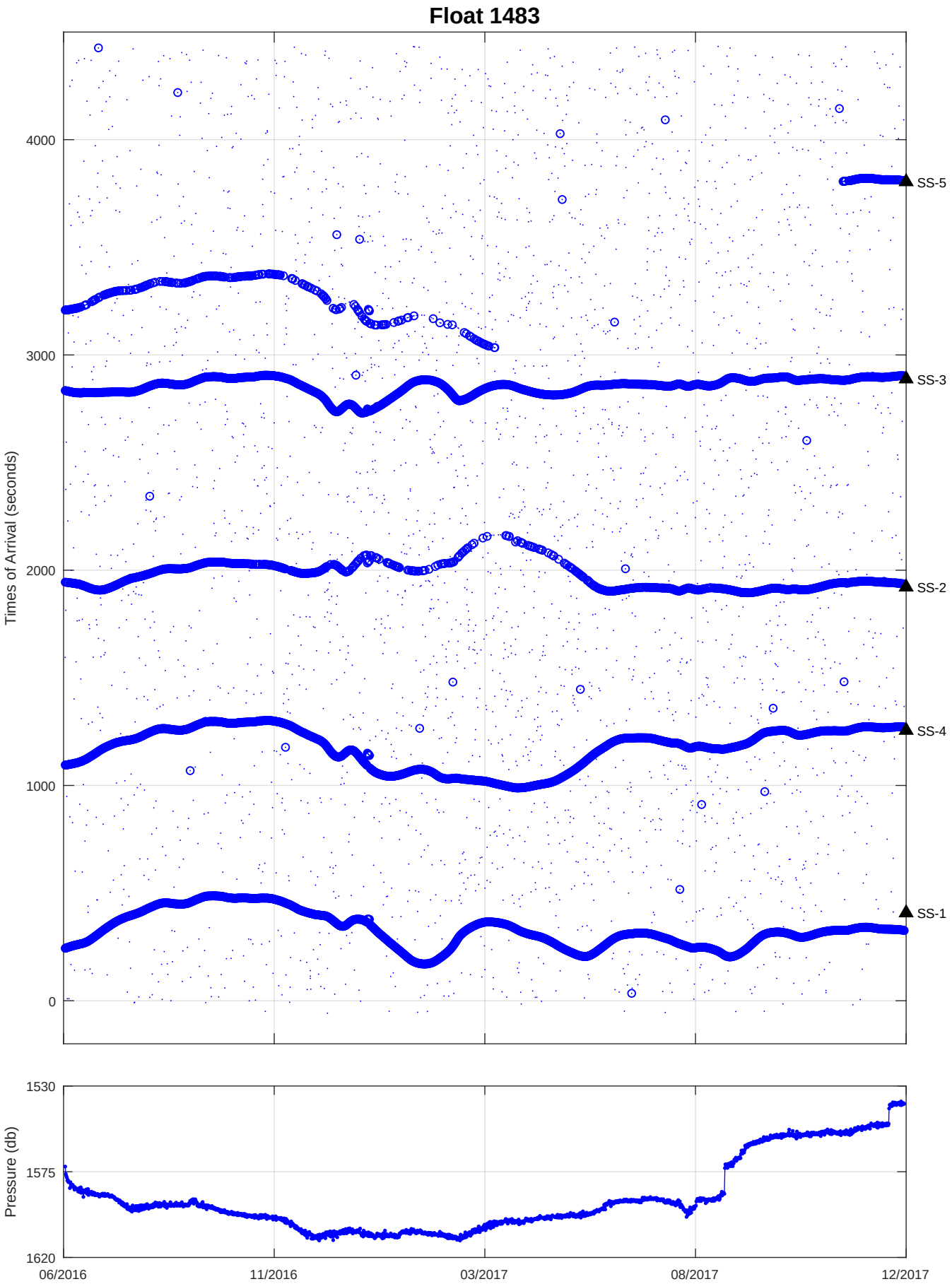
Float 1478

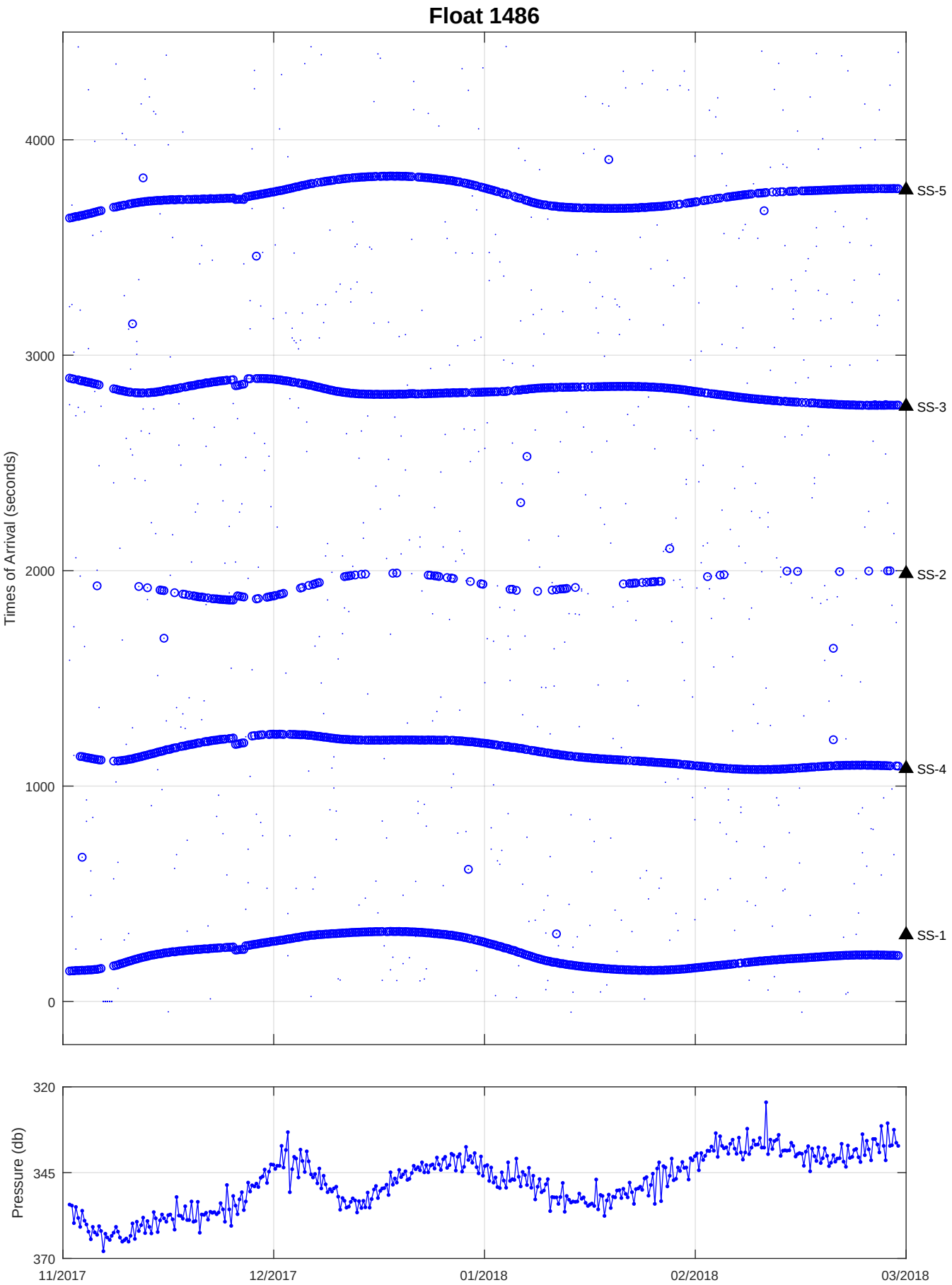

Times of Arrival (seconds)
4000
3000
2000
1000
0
SS-5
SS-3
SS-2
SS-4
SS-1
Pressure (db)
1400
1425
1450
10/2016
03/2017
07/2017
11/2017
04/2018

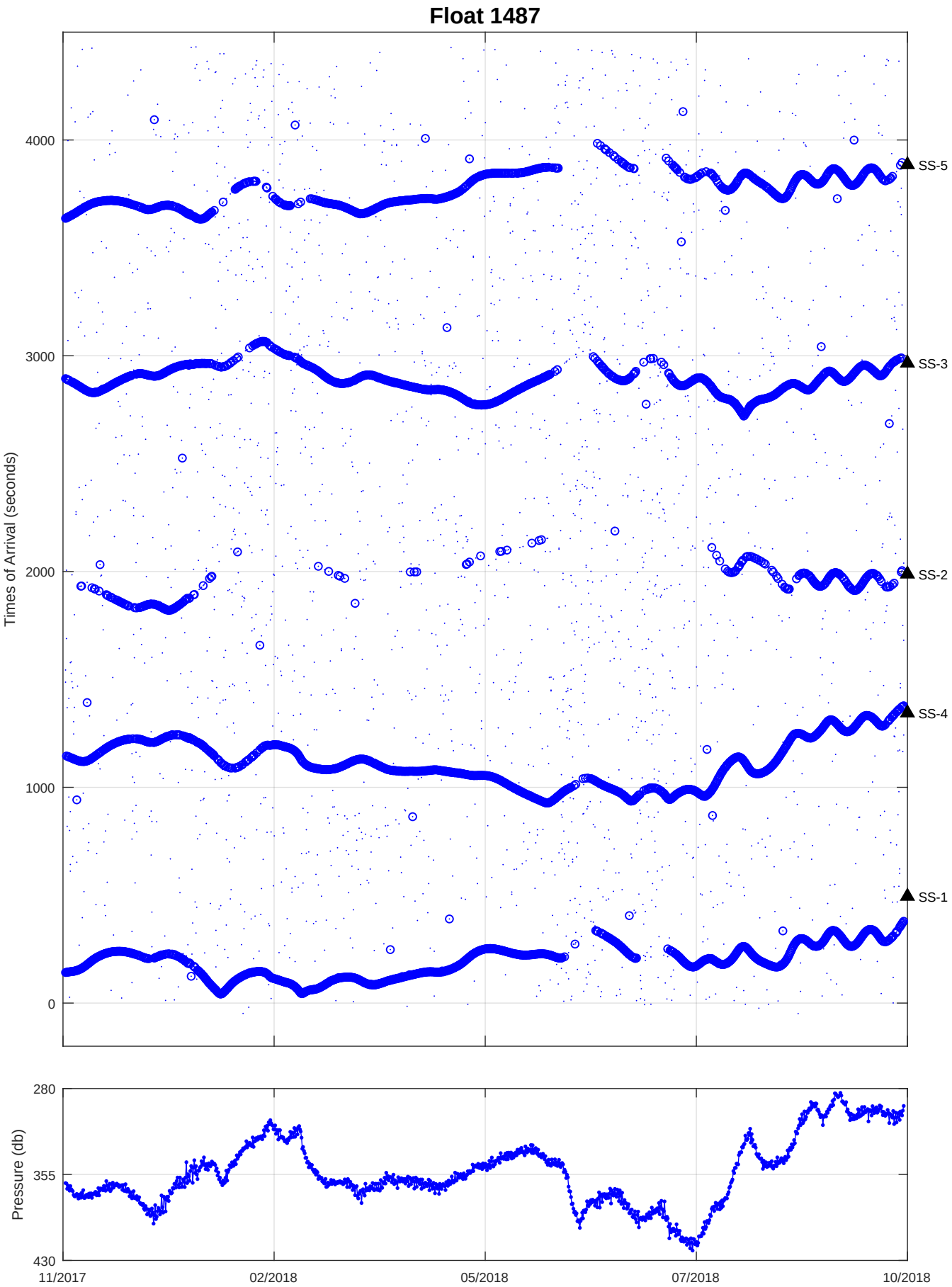

Float 1479
Times of Arrival (seconds)
4000
3000
2000
1000
0
SS-5
SS-3
SS-2
SS-4
SS-1
Pressure (db)
1400
1420
1440
10/2016
03/2017
07/2017
11/2017
04/2018

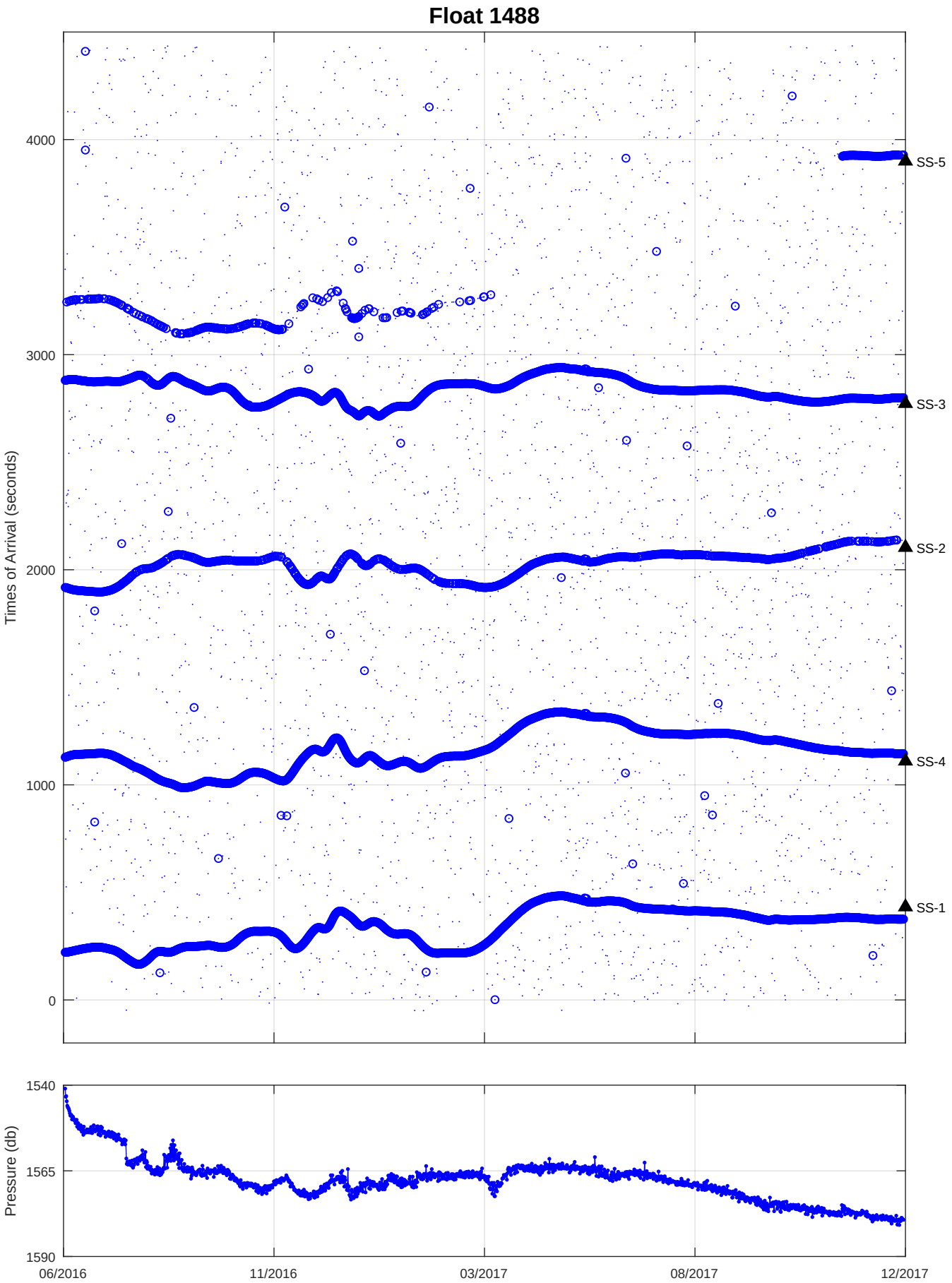

Float 1480
Times of Arrival (seconds)
4000
3000
2000
1000
0
SS-5
SS-3
SS-2
SS-4
SS-1
Pressure (db)
1540
1565
1590
06/2016
11/2016
03/2017
08/2017
12/2017

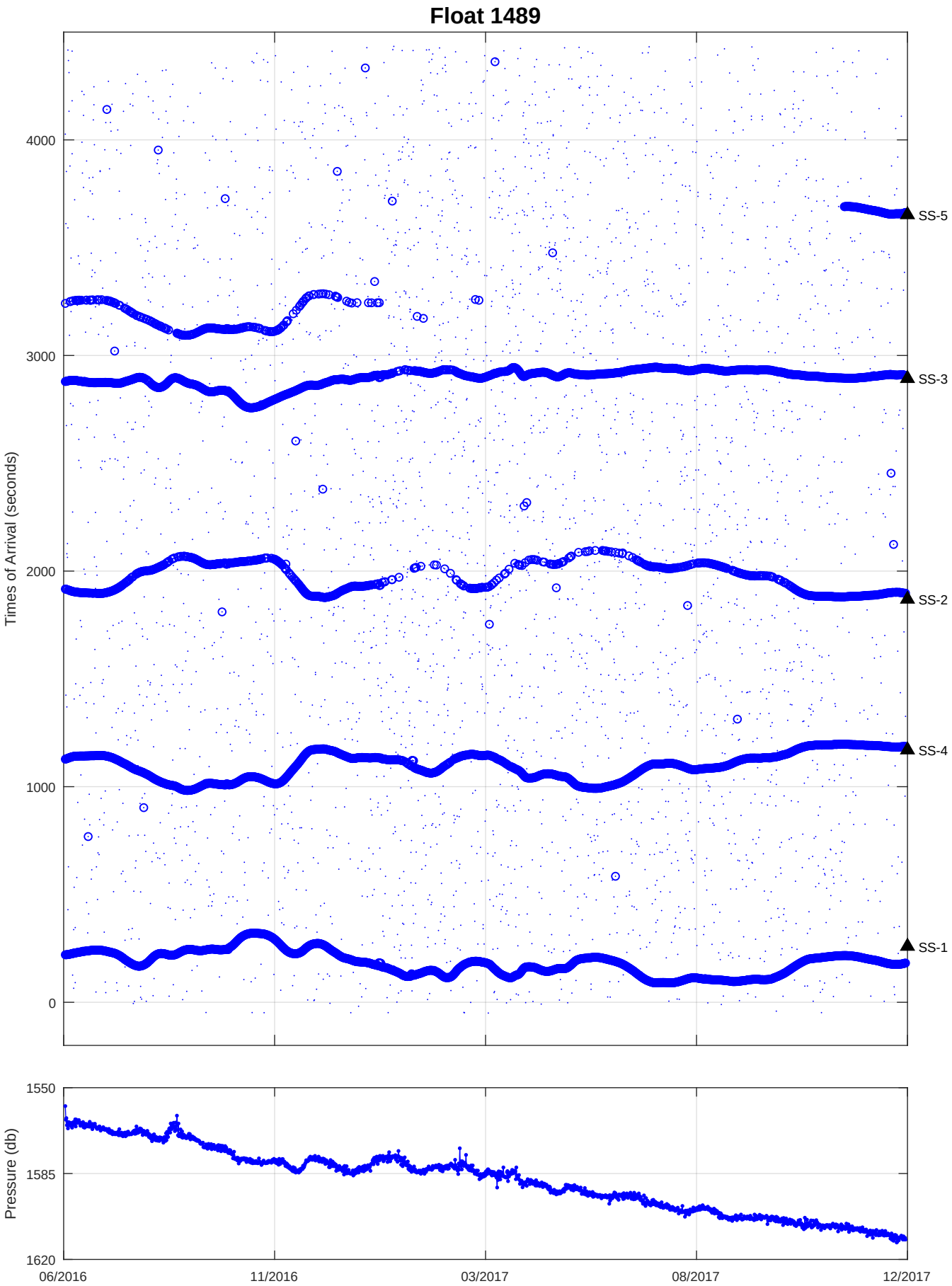

Float 1481
Times of Arrival (seconds)
4000
3000
2000
1000
0
SS-5
SS-3
SS-2
SS-4
SS-1
Pressure (db)
1540
1560
1580
06/2016
11/2016
03/2017
08/2017
12/2017

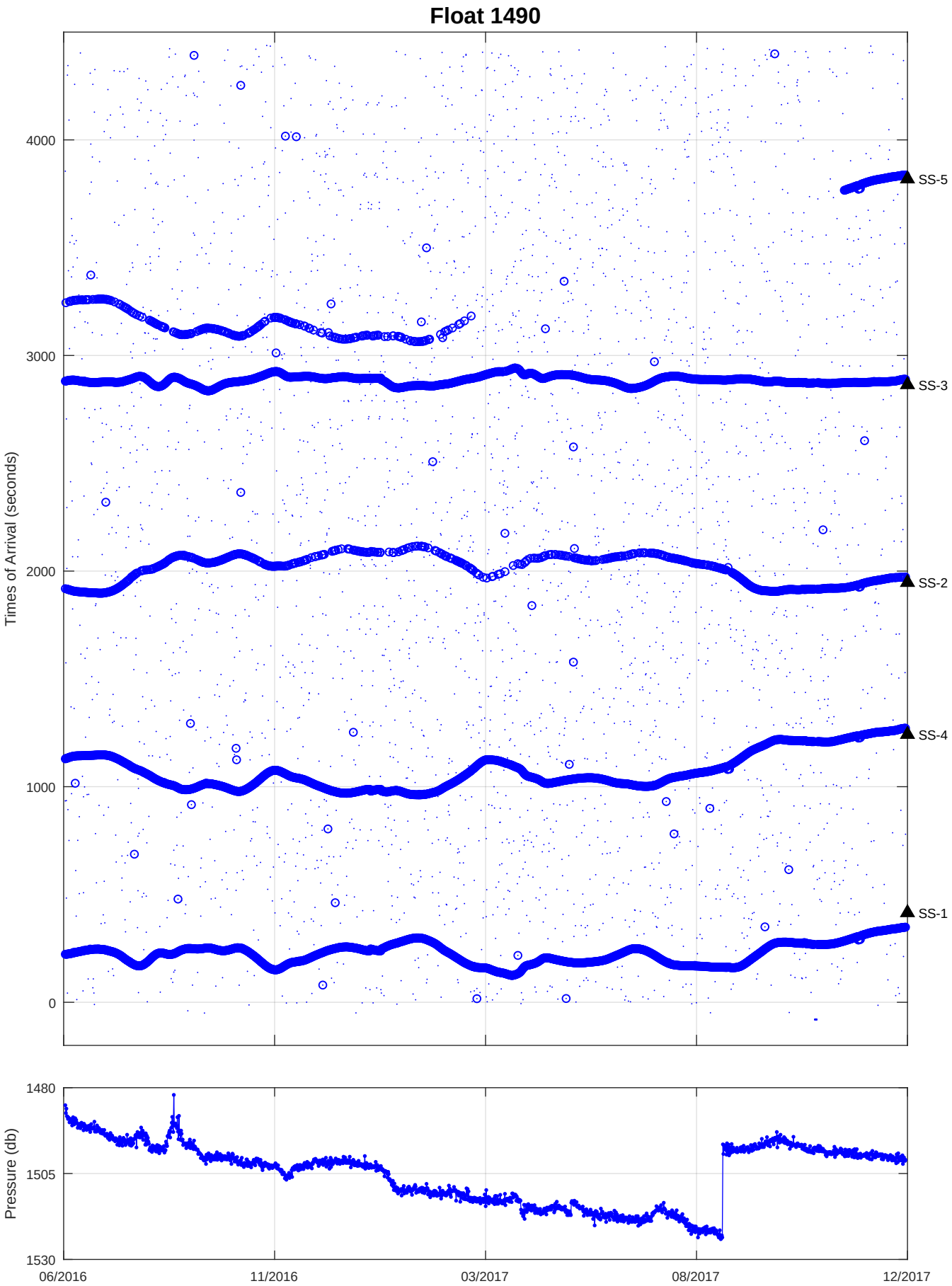

Float 1483
Times of Arrival (seconds)
4000
3000
2000
1000
0
SS-5
SS-3
SS-2
SS-4
SS-1
Pressure (db)
1530
1575
1620
06/2016
11/2016
03/2017
08/2017
12/2017

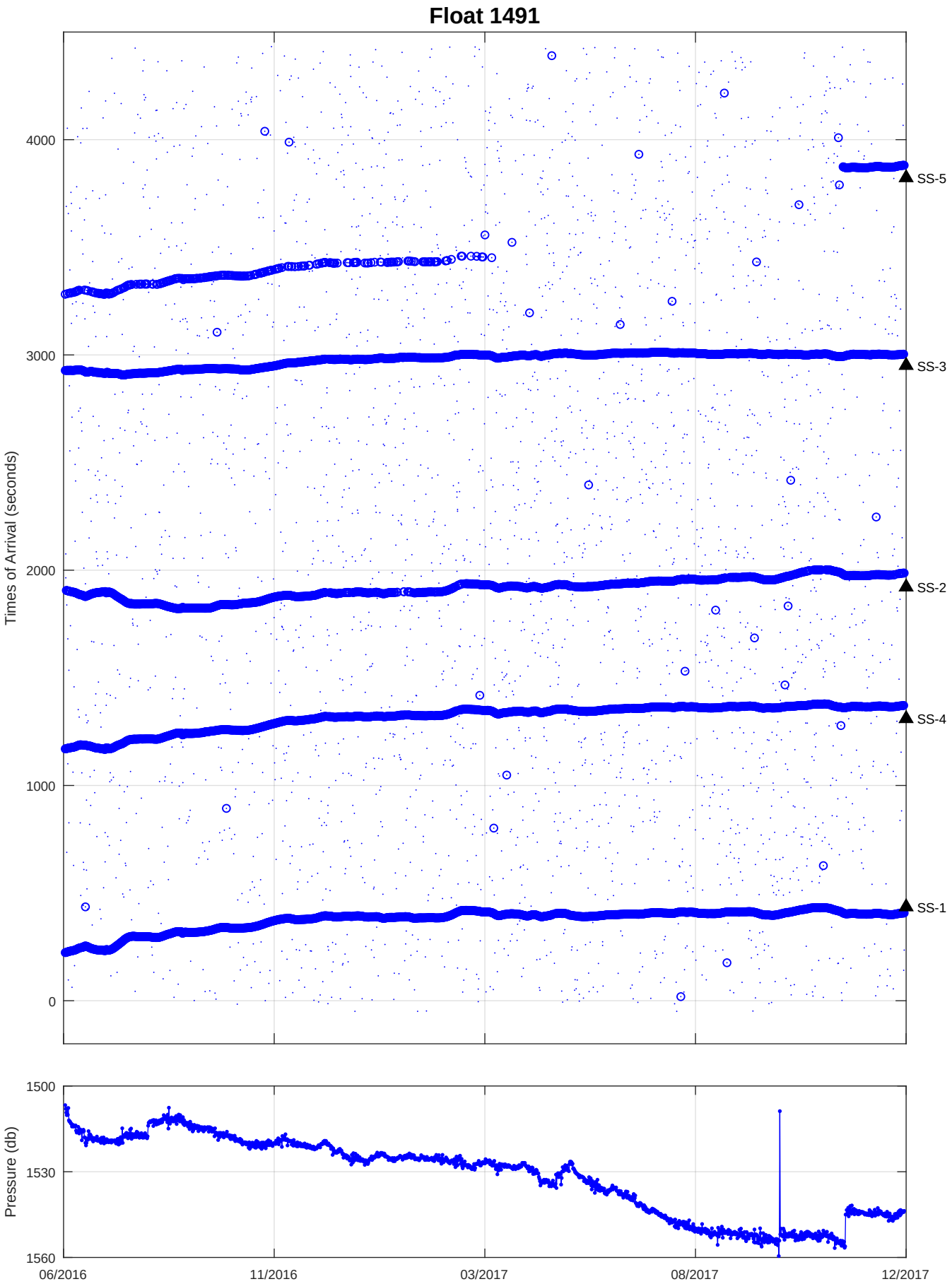

Float 1486
Times of Arrival (seconds)
4000
3000
2000
1000
0
SS-5
SS-3
SS-2
SS-4
SS-1
Pressure (db)
320
345
370
11/2017
12/2017
01/2018
02/2018
03/2018

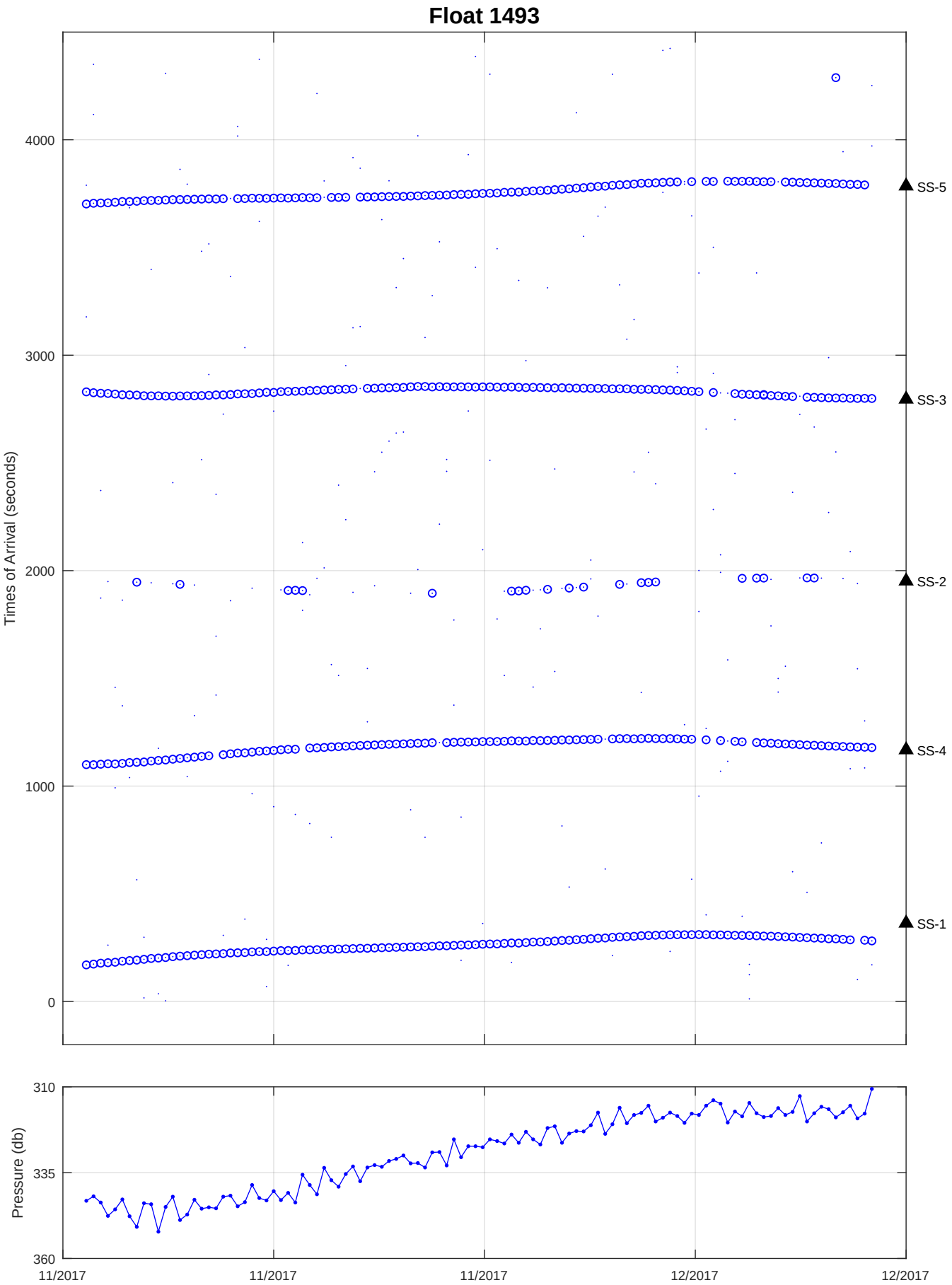

Float 1487
Times of Arrival (seconds)
4000
3000
2000
1000
0
SS-5
SS-3
SS-2
SS-4
SS-1
Pressure (db)
280
355
430
11/2017
02/2018
05/2018
07/2018
10/2018

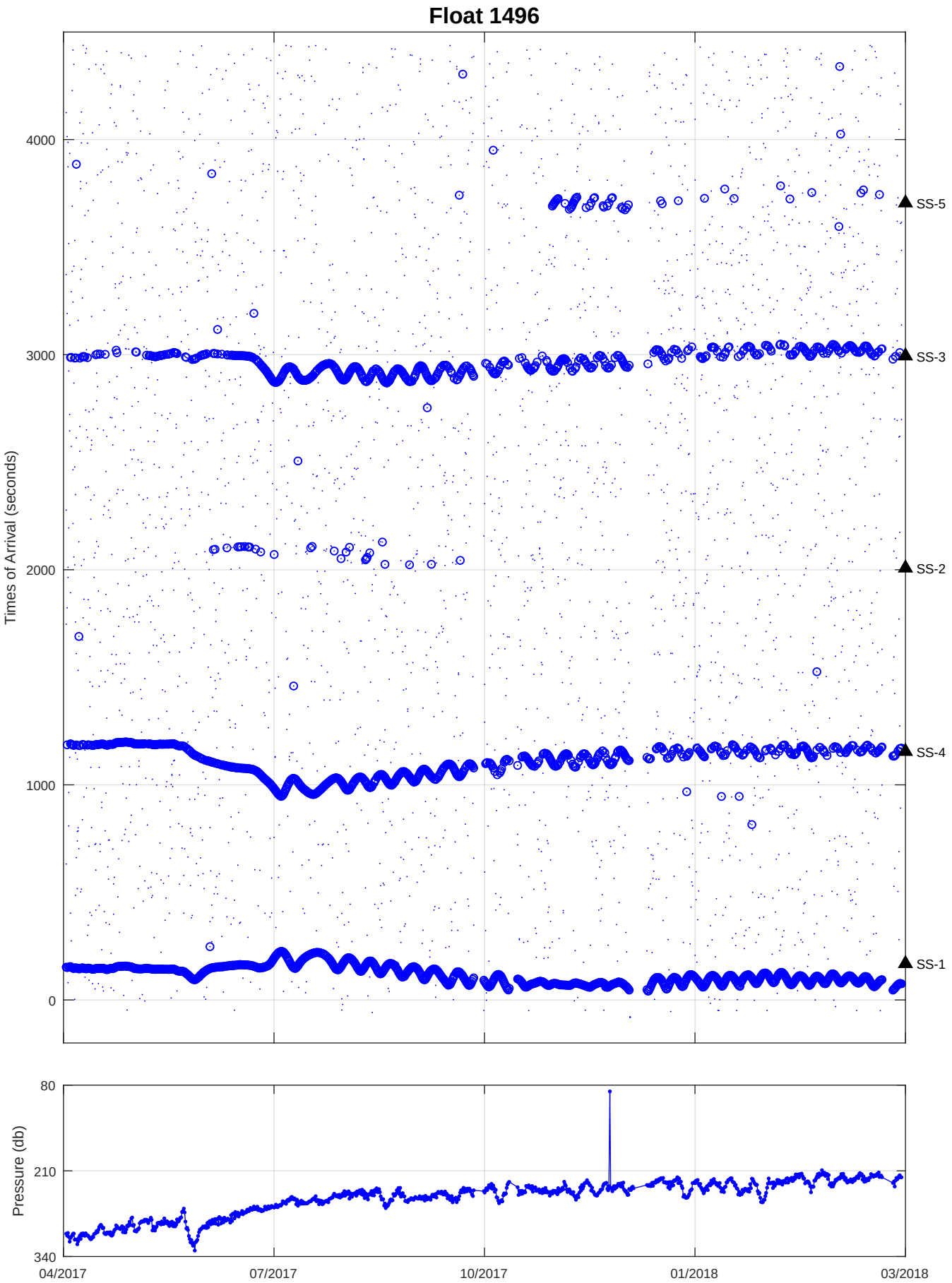

Float 1488
Times of Arrival (seconds)
4000
3000
2000
1000
0
SS-5
SS-3
SS-2
SS-4
SS-1
Pressure (db)
1540
1565
1590
06/2016
11/2016
03/2017
08/2017
12/2017

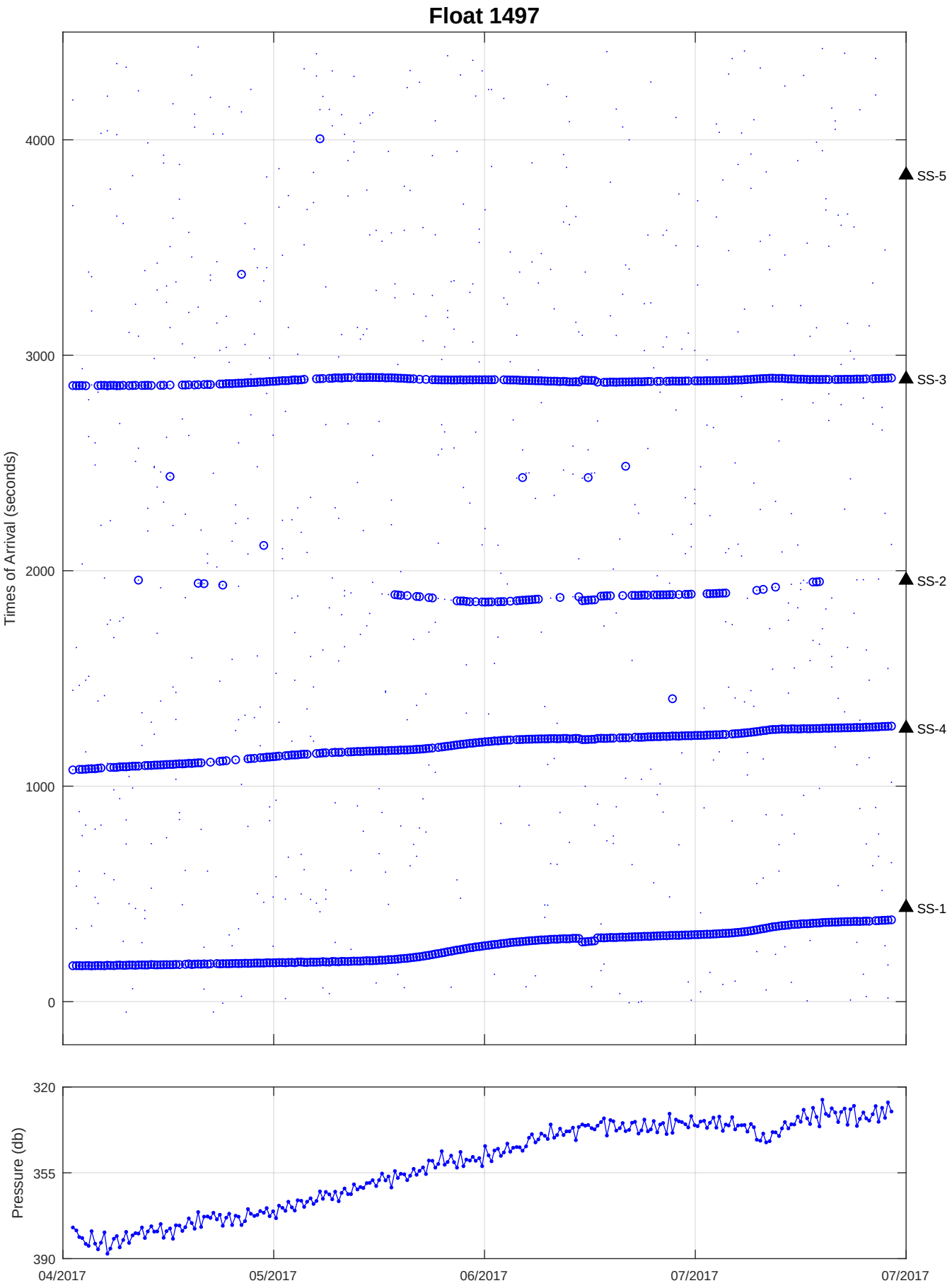

Float 1489
Times of Arrival (seconds)
4000
3000
2000
1000
0
SS-5
SS-3
SS-2
SS-4
SS-1
Pressure (db)
1550
1585
1620
06/2016
11/2016
03/2017
08/2017
12/2017


Float 1490
Times of Arrival (seconds)
4000
3000
2000
1000
0
SS-5
SS-3
SS-2
SS-4
SS-1
Pressure (db)
1480
1505
1530
06/2016
11/2016
03/2017
08/2017
12/2017

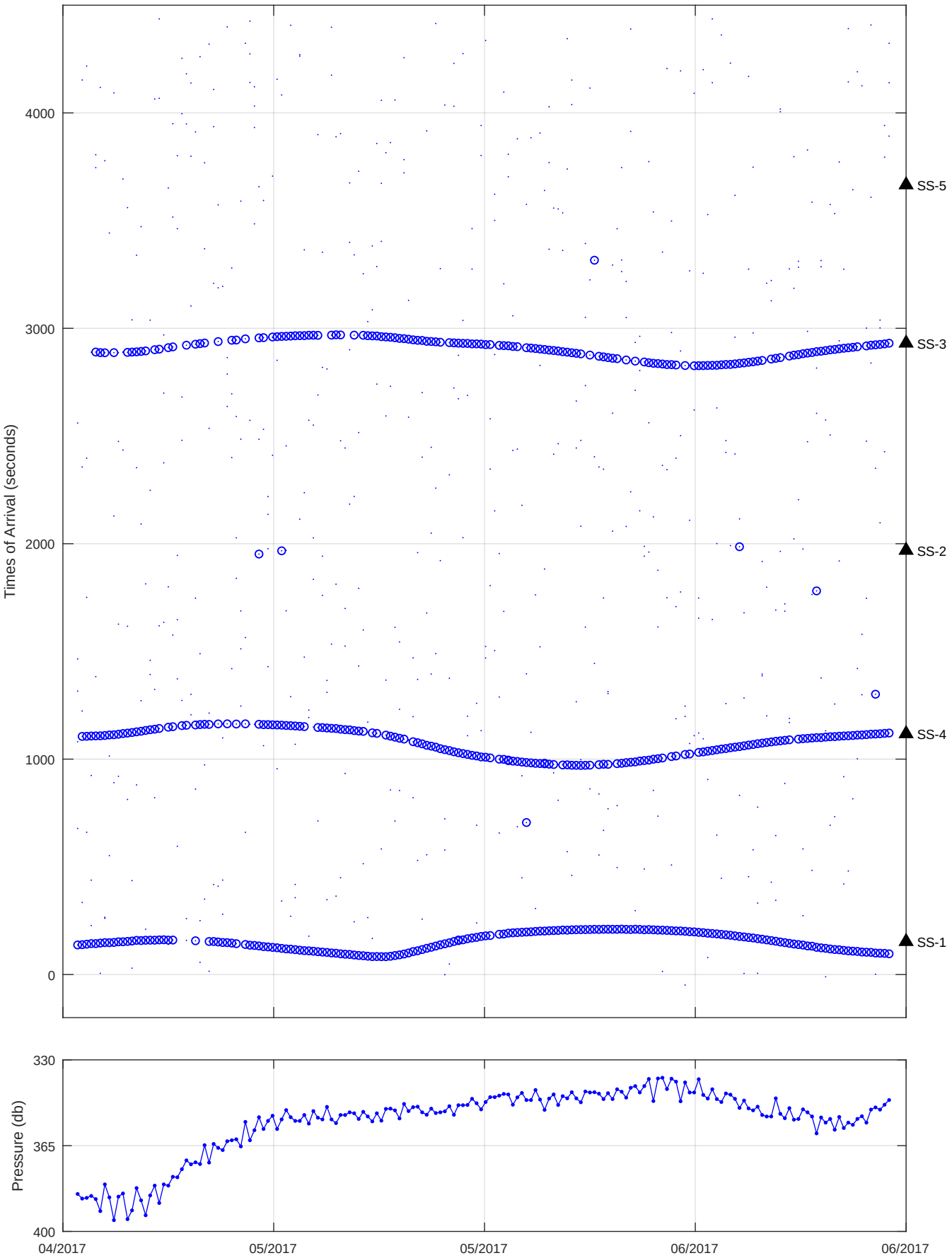

Float 1491
Times of Arrival (seconds)
4000
3000
2000
1000
0
SS-5
SS-3
SS-2
SS-4
SS-1
Pressure (db)
1500
1530
1560
06/2016
11/2016
03/2017
08/2017
12/2017

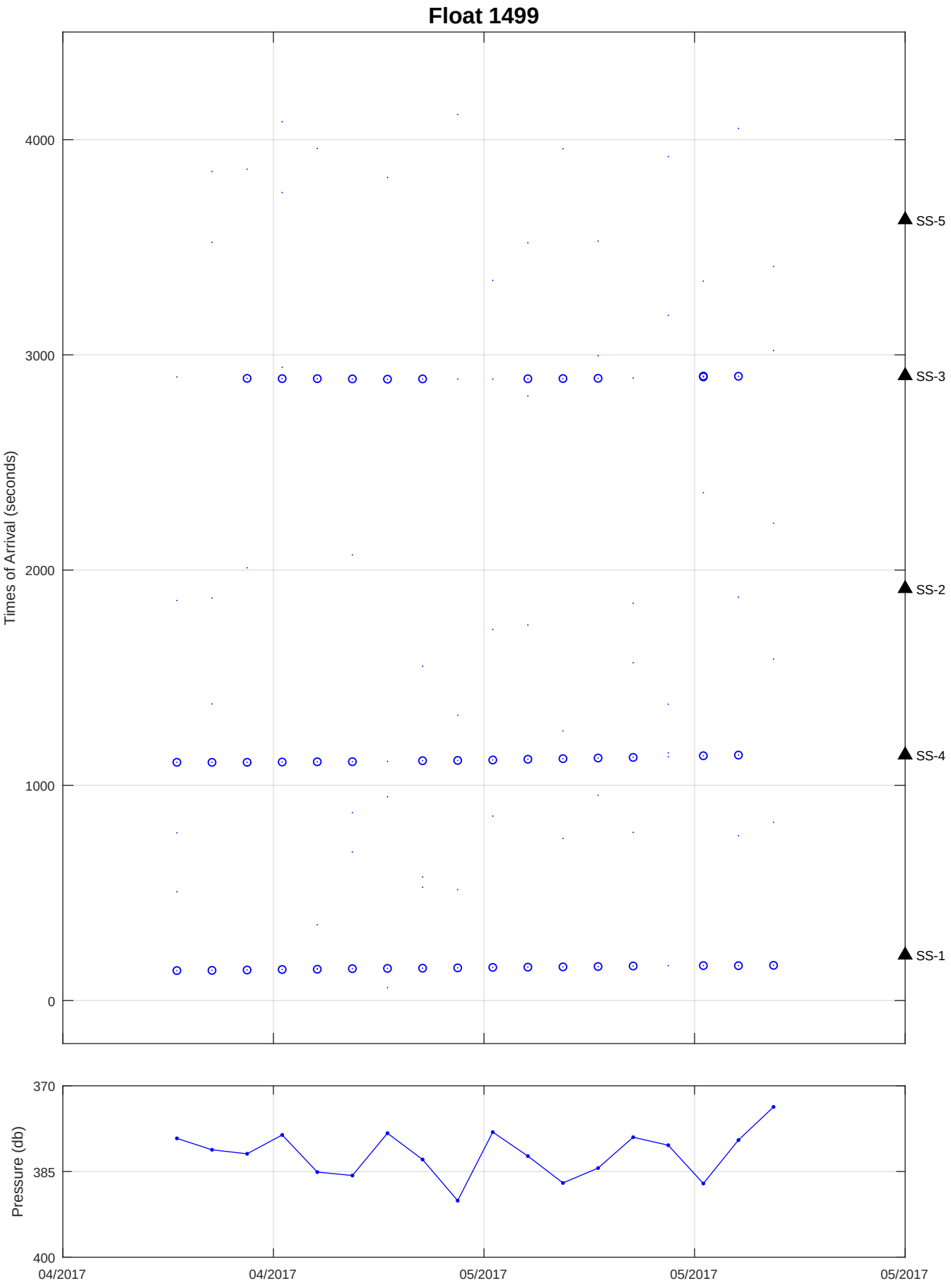

Float 1493
Times of Arrival (seconds)
4000
3000
2000
1000
0
SS-5
SS-3
SS-2
SS-4
SS-1
Pressure (db)
310
335
360
11/2017
11/2017
11/2017
12/2017
12/2017

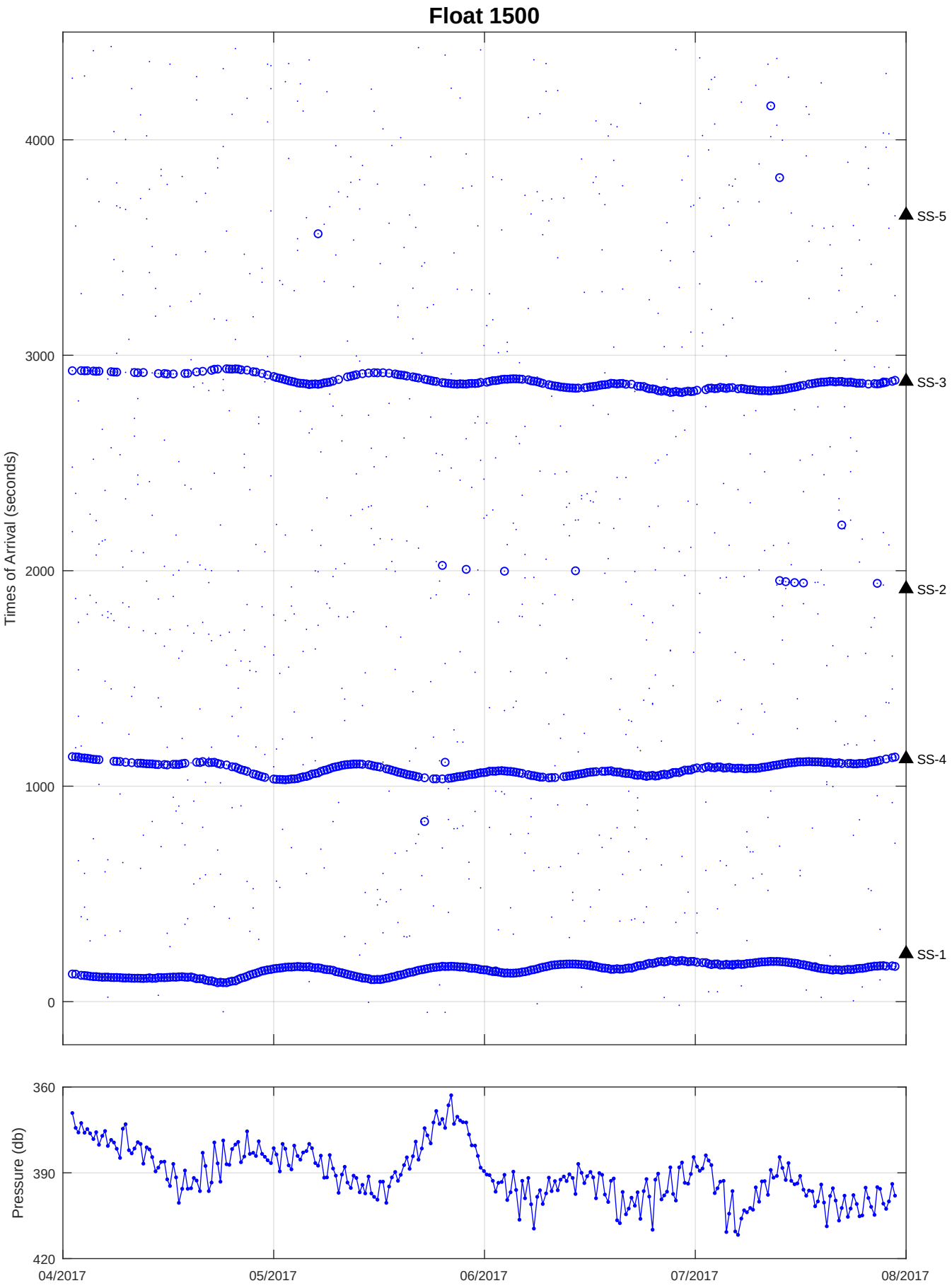

Float 1496
Times of Arrival (seconds)
4000
3000
2000
1000
0
SS-5
SS-3
SS-2
SS-4
SS-1
Pressure (db)
80
210
340
04/2017
07/2017
10/2017
01/2018
03/2018

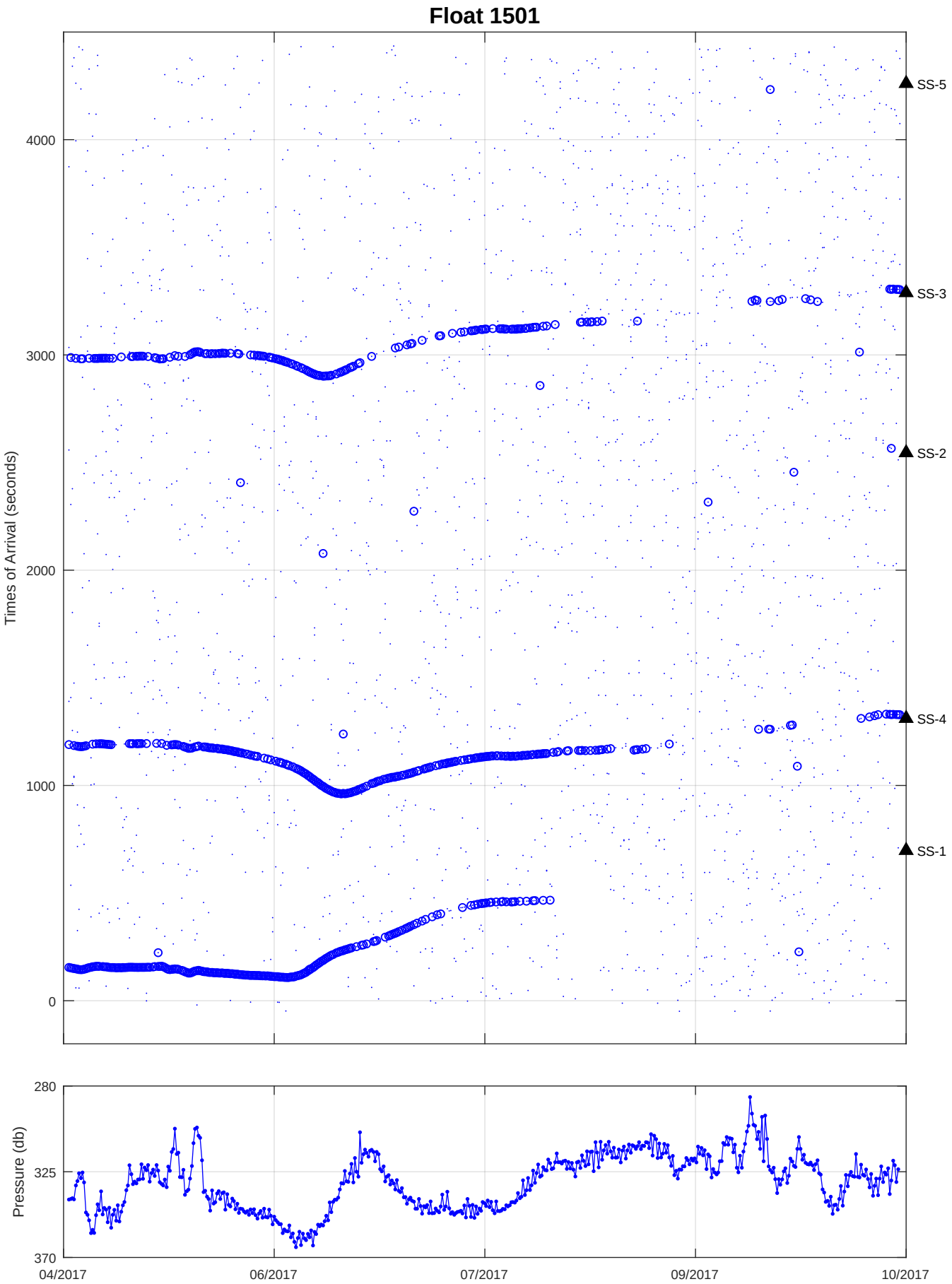

Float 1497
Times of Arrival (seconds)
4000
3000
2000
1000
0
SS-5
SS-3
SS-2
SS-4
SS-1
Pressure (db)
320
355
390
04/2017
05/2017
06/2017
07/2017
07/2017

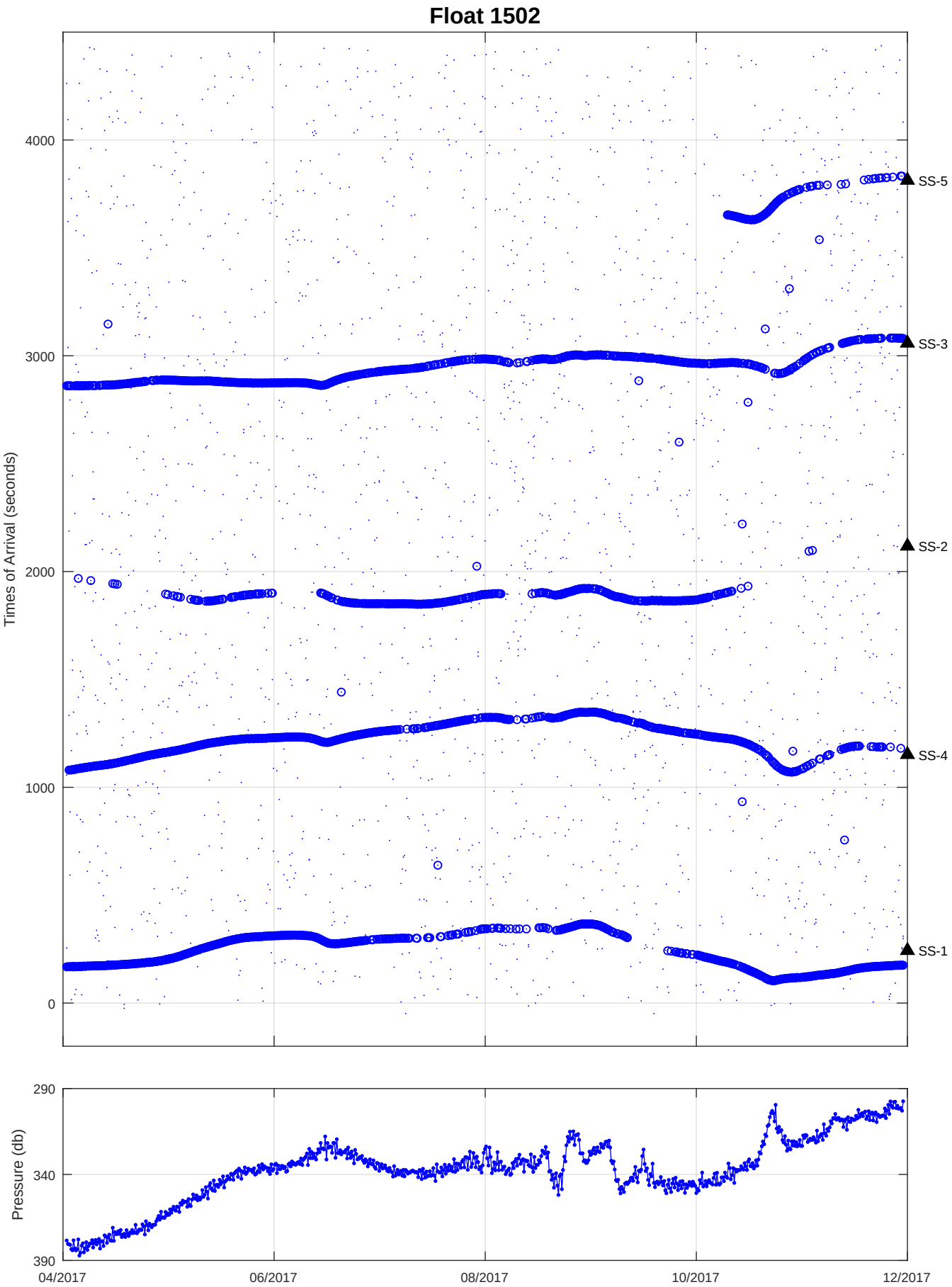
Float 1498

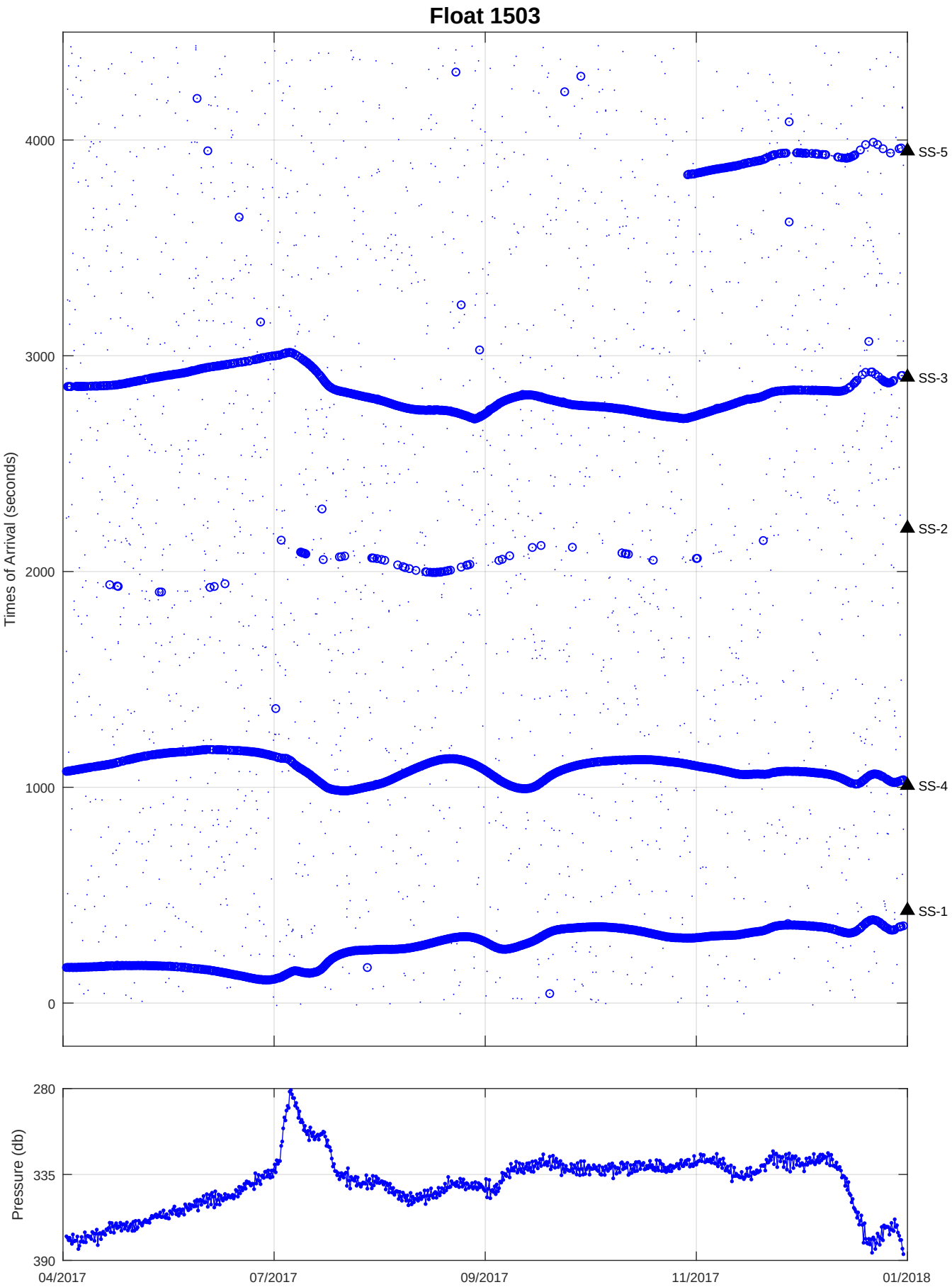

Times of Arrival (seconds)
4000
3000
2000
1000
0
SS-5
SS-3
SS-2
SS-4
SS-1
Pressure (db)
330
365
400
04/2017
05/2017
05/2017
06/2017
06/2017

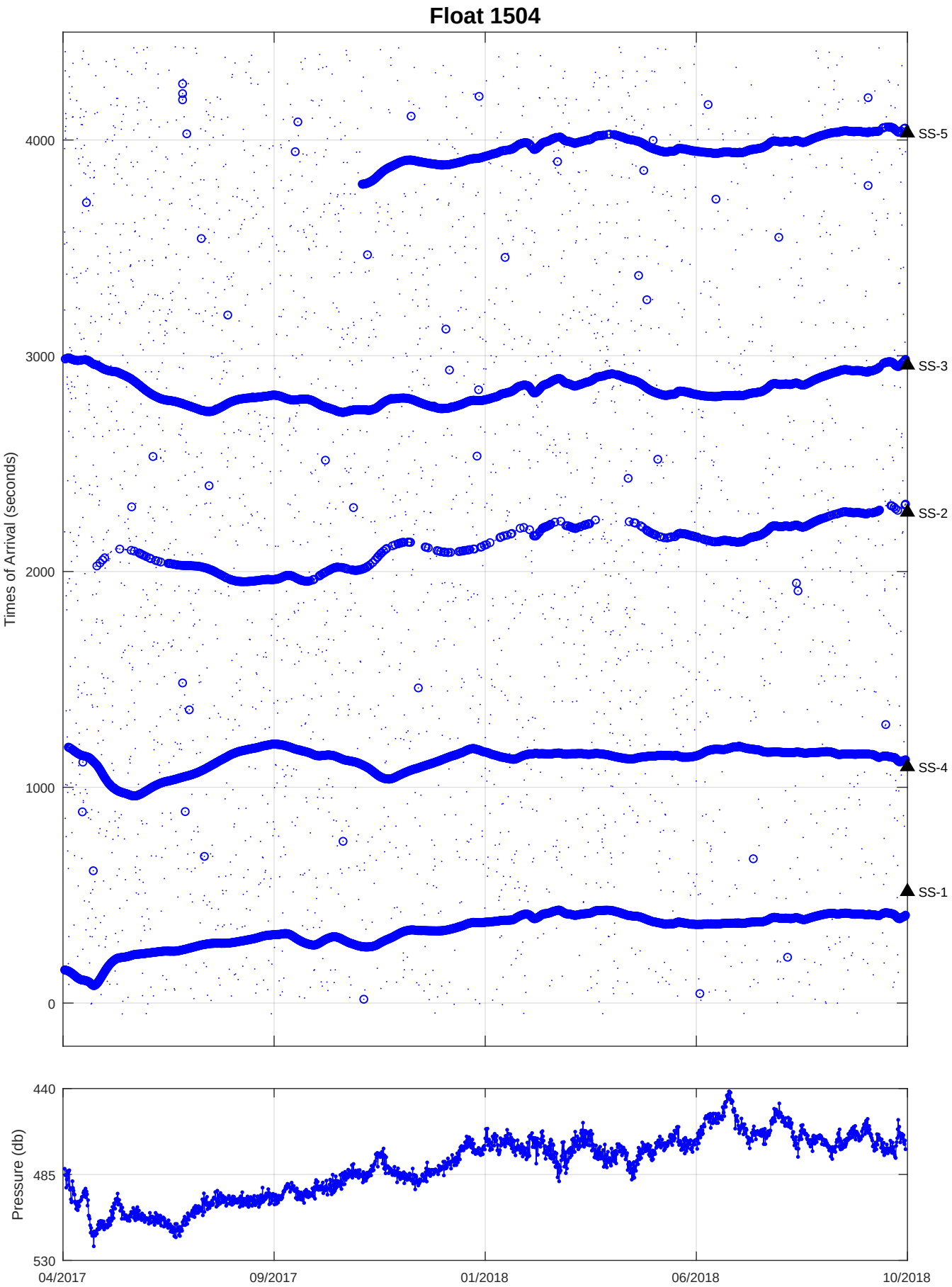

Float 1499
Times of Arrival (seconds)
4000
3000
2000
1000
0
SS-5
SS-3
SS-2
SS-4
SS-1
Pressure (db)
370
385
400
04/2017
04/2017
05/2017
05/2017
05/2017

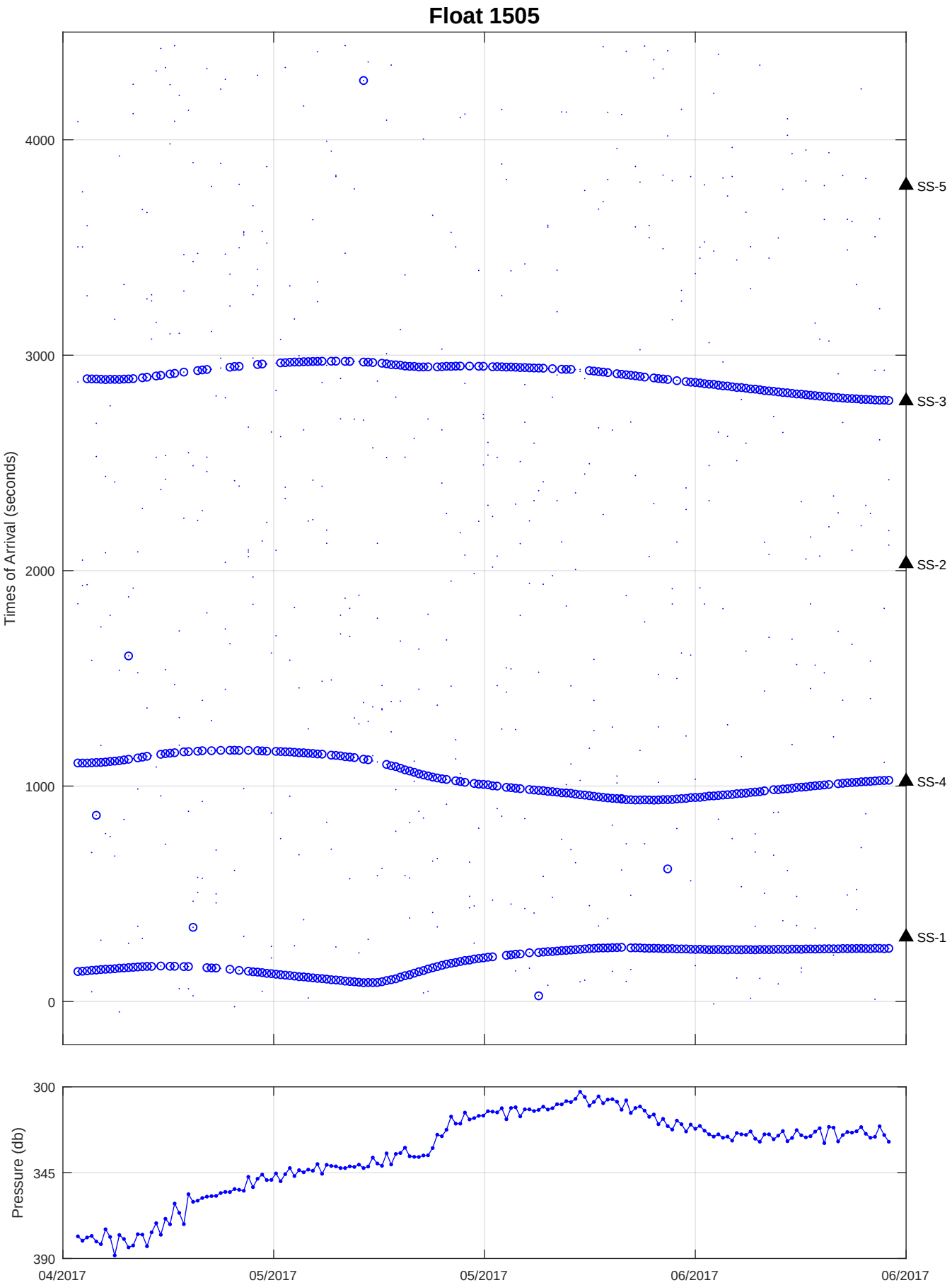

Float 1500
Times of Arrival (seconds)
4000
3000
2000
1000
0
SS-5
SS-3
SS-2
SS-4
SS-1
Pressure (db)
360
390
420
04/2017
05/2017
06/2017
07/2017
08/2017

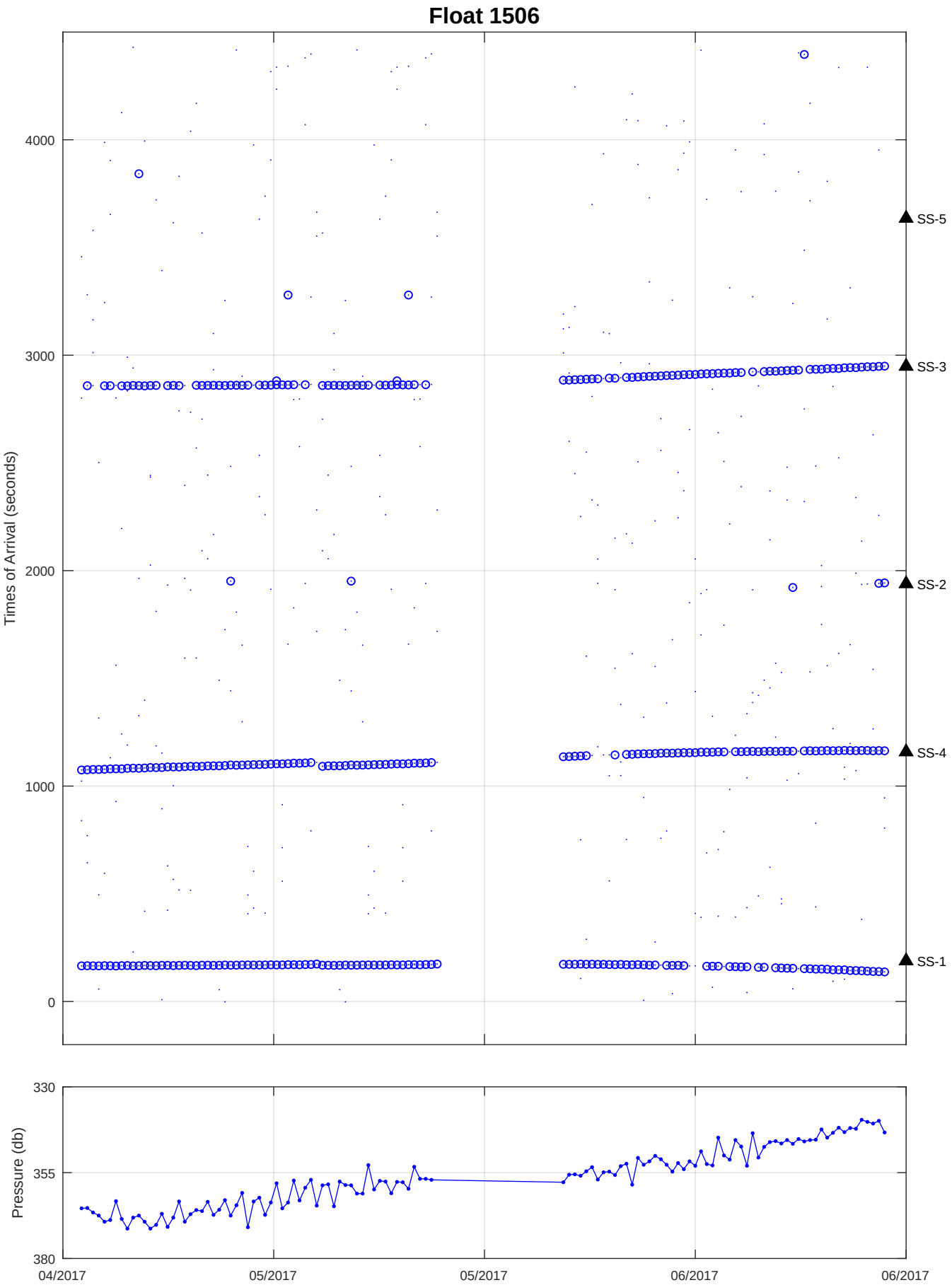

Float 1501
SS-5
SS-3
SS-2
SS-4
SS-1
Times of Arrival (seconds)
4000
3000
2000
1000
0
Pressure (db)
280
325
370
04/2017
06/2017
07/2017
09/2017
10/2017

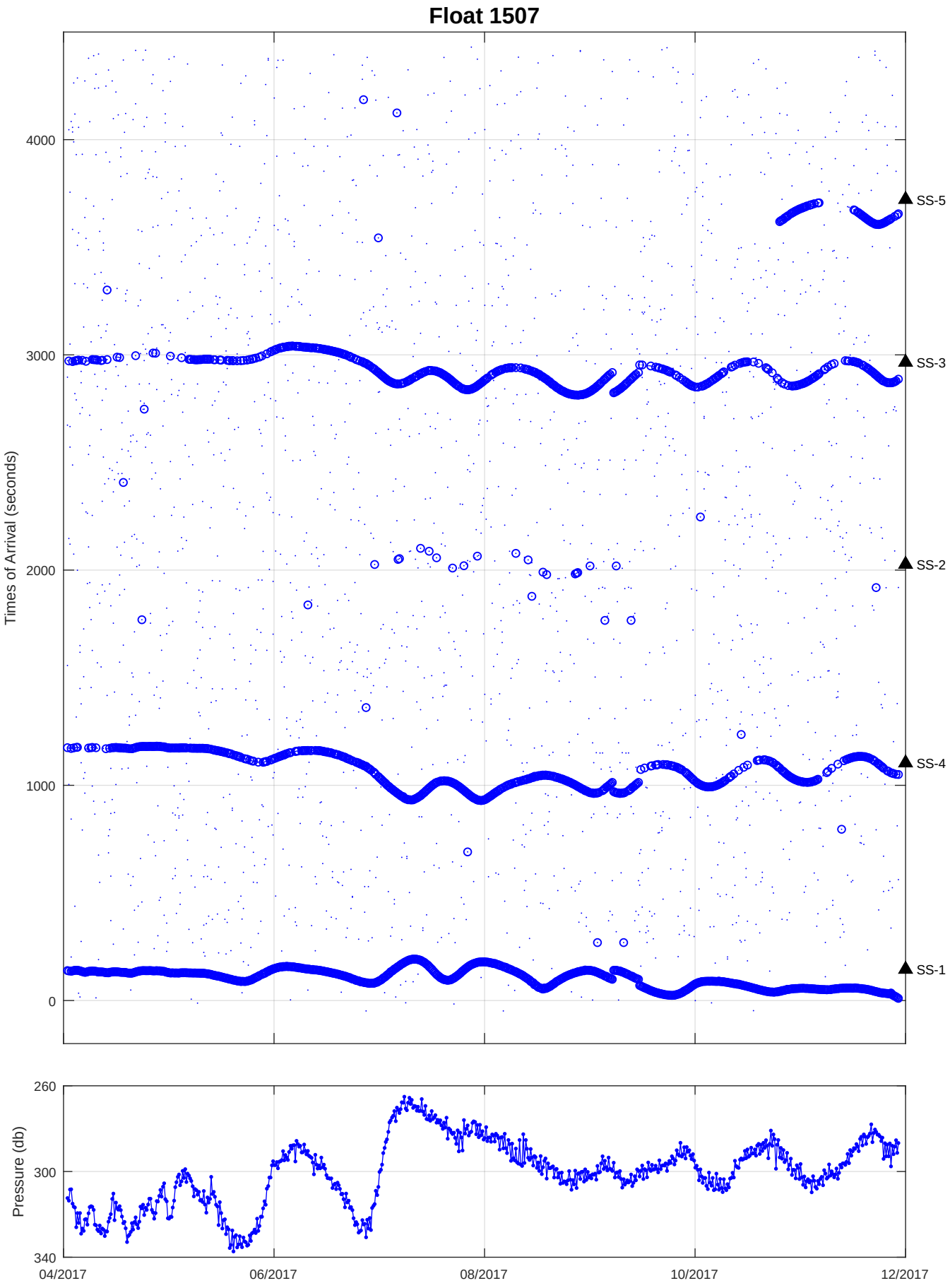

Float 1502
Times of Arrival (seconds)
4000
3000
2000
1000
0
SS-5
SS-3
SS-2
SS-4
SS-1
Pressure (db)
290
340
390
04/2017
06/2017
08/2017
10/2017
12/2017

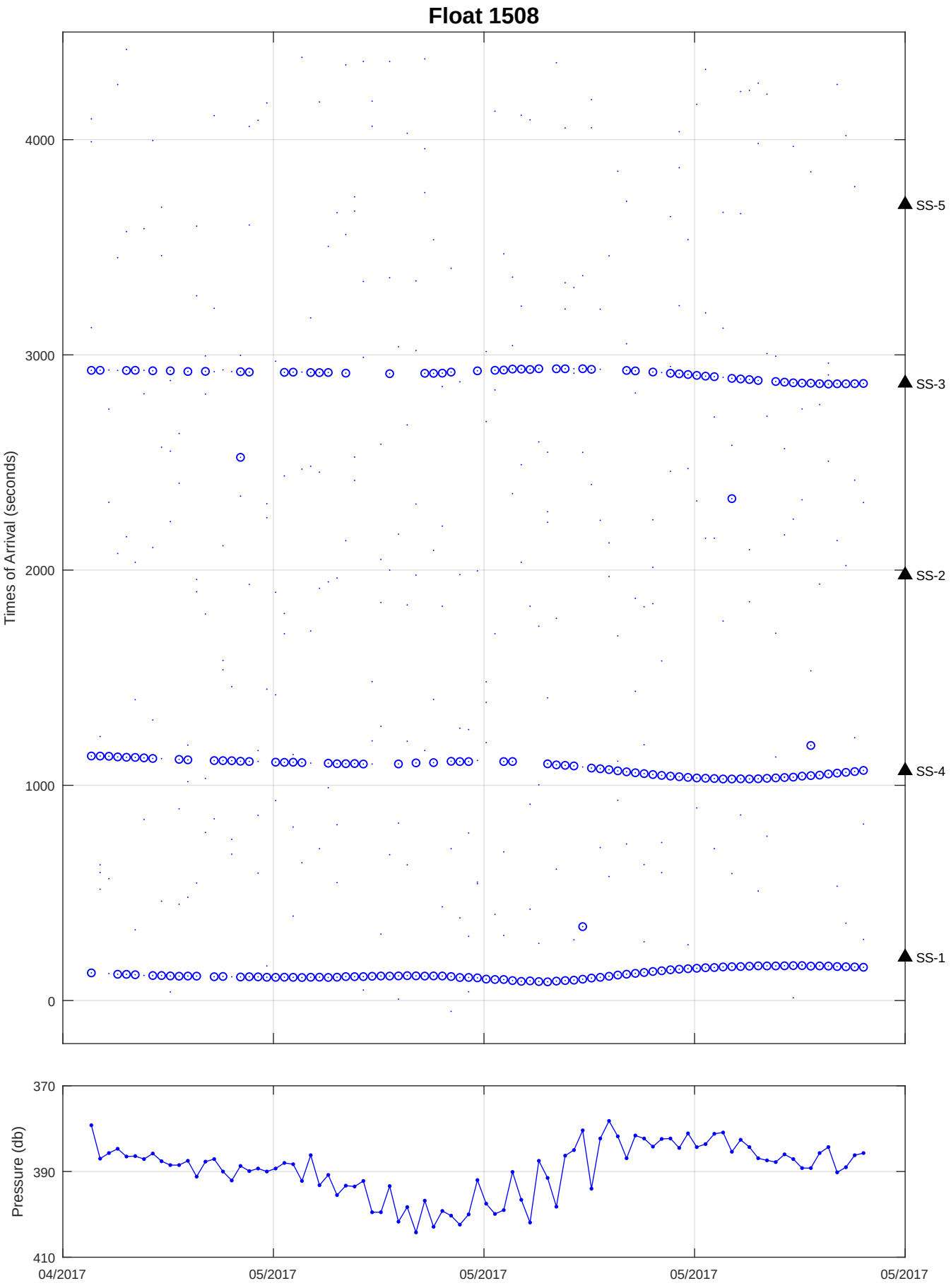

Float 1503
Times of Arrival (seconds)
4000
3000
2000
1000
0
SS-5
SS-3
SS-2
SS-4
SS-1
Pressure (db)
280
335
390
04/2017
07/2017
09/2017
11/2017
01/2018

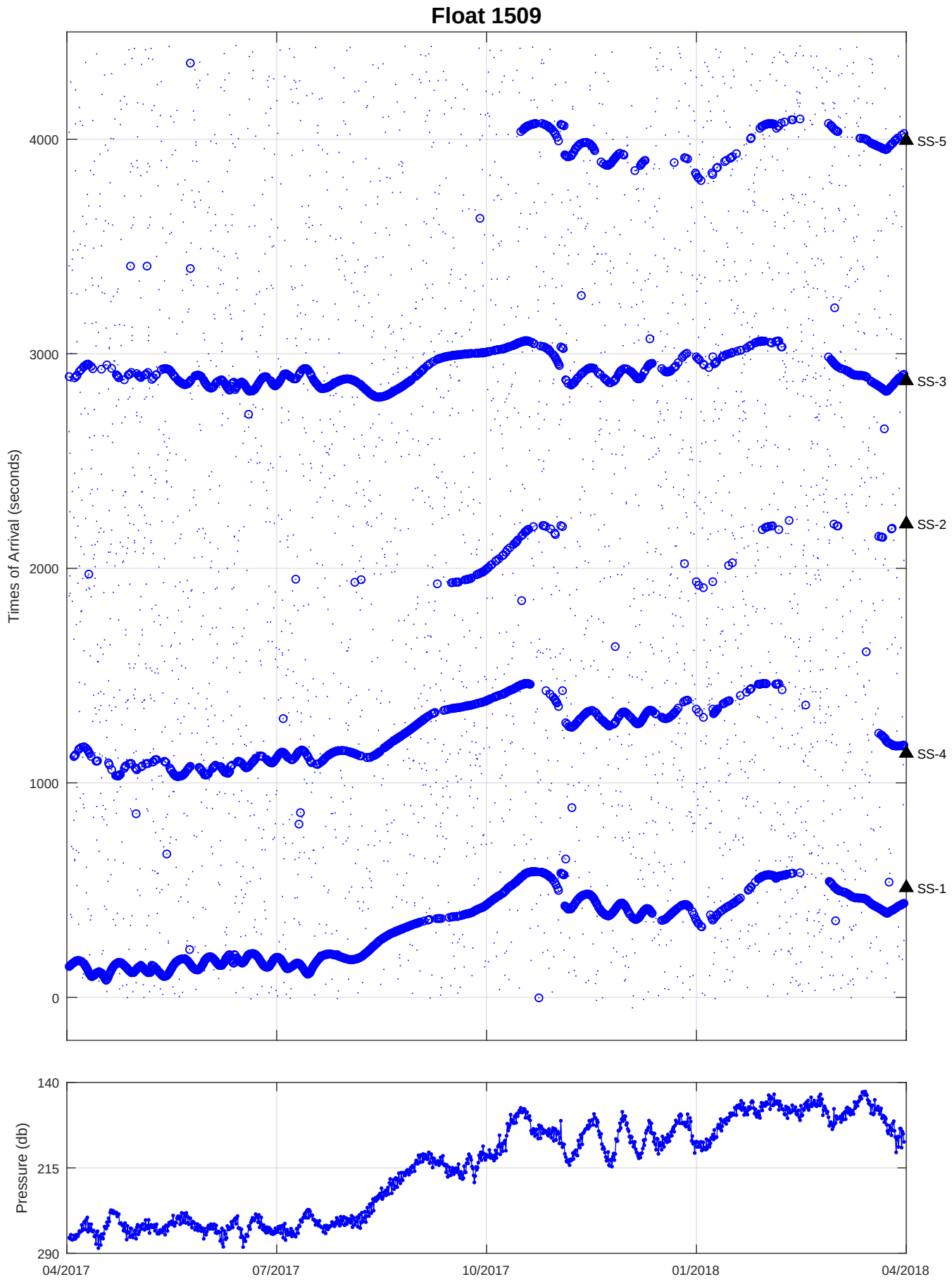

Float 1504
Times of Arrival (seconds)
4000
3000
2000
1000
0
SS-5
SS-3
SS-2
SS-4
SS-1
Pressure (db)
440
485
530
04/2017
09/2017
01/2018
06/2018
10/2018

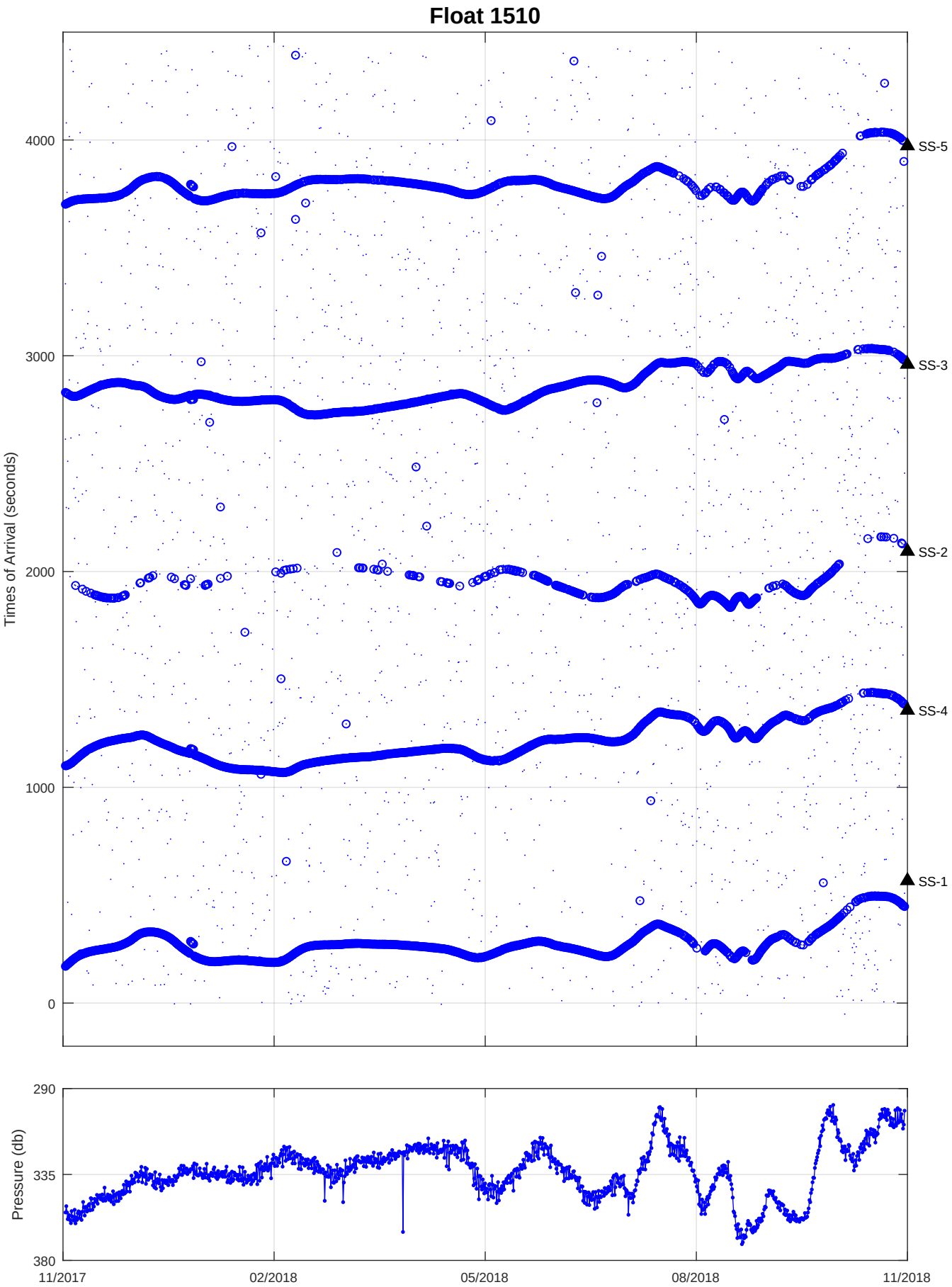

Float 1505
Times of Arrival (seconds)
4000
3000
2000
1000
0
SS-5
SS-3
SS-2
SS-4
SS-1
Pressure (db)
300
345
390
04/2017
05/2017
05/2017
06/2017
06/2017

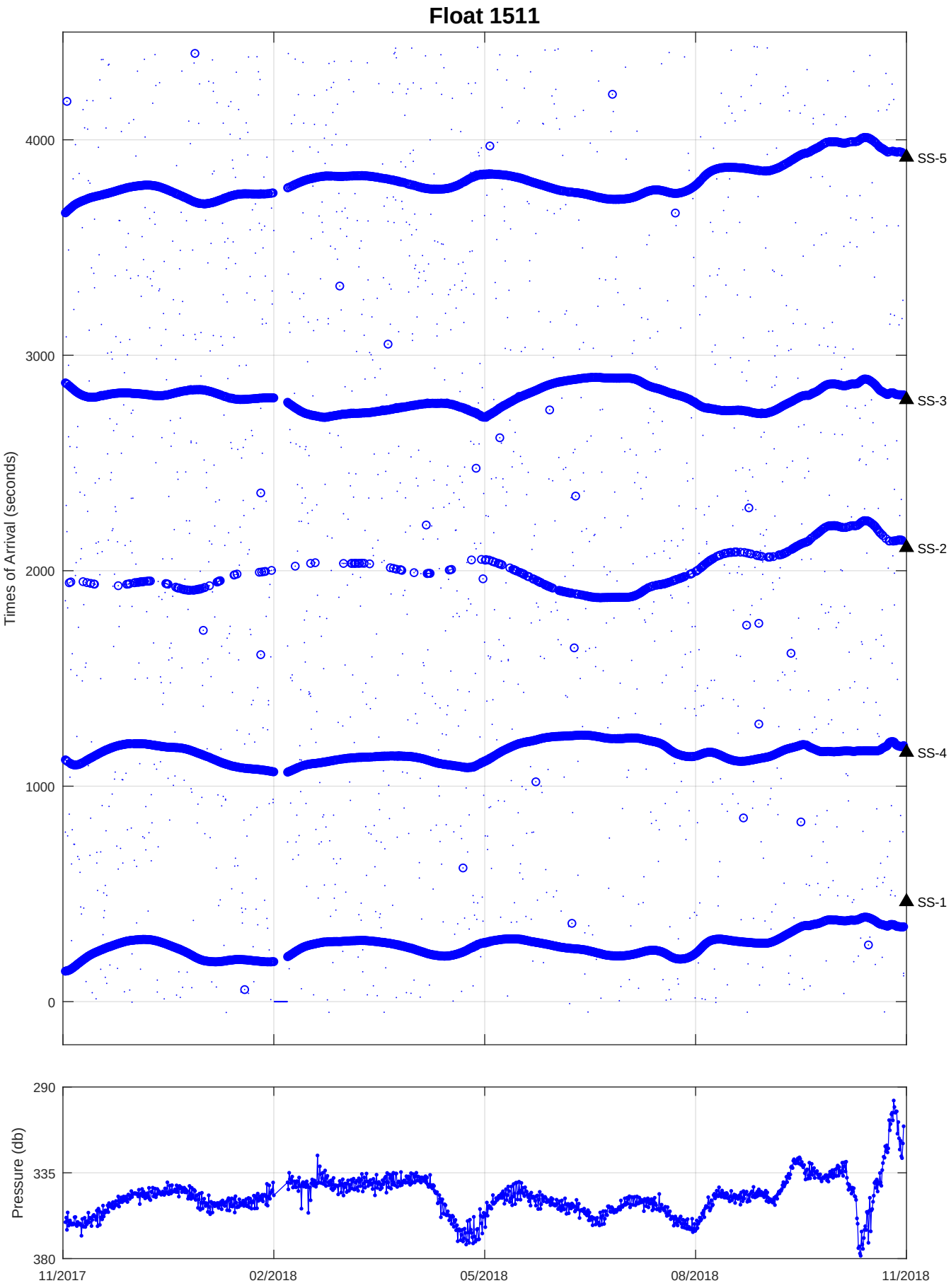

Float 1506
Times of Arrival (seconds)
4000
3000
2000
1000
0
SS-5
SS-3
SS-2
SS-4
SS-1
Pressure (db)
330
355
380
04/2017
05/2017
05/2017
06/2017
06/2017

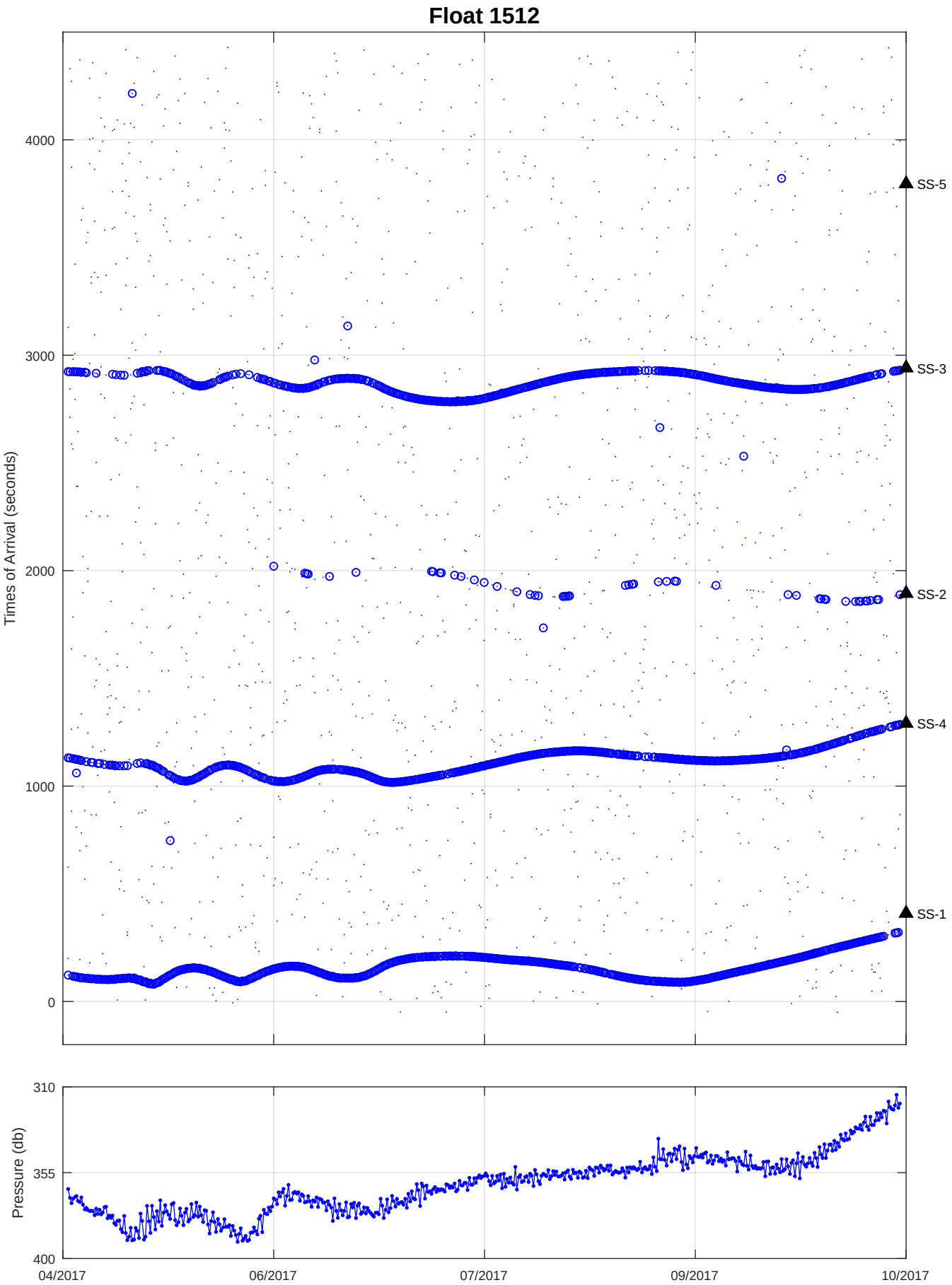

Float 1507
Times of Arrival (seconds)
4000
3000
2000
1000
0
SS-5
SS-3
SS-2
SS-4
SS-1
Pressure (db)
260
300
340
04/2017
06/2017
08/2017
10/2017
12/2017

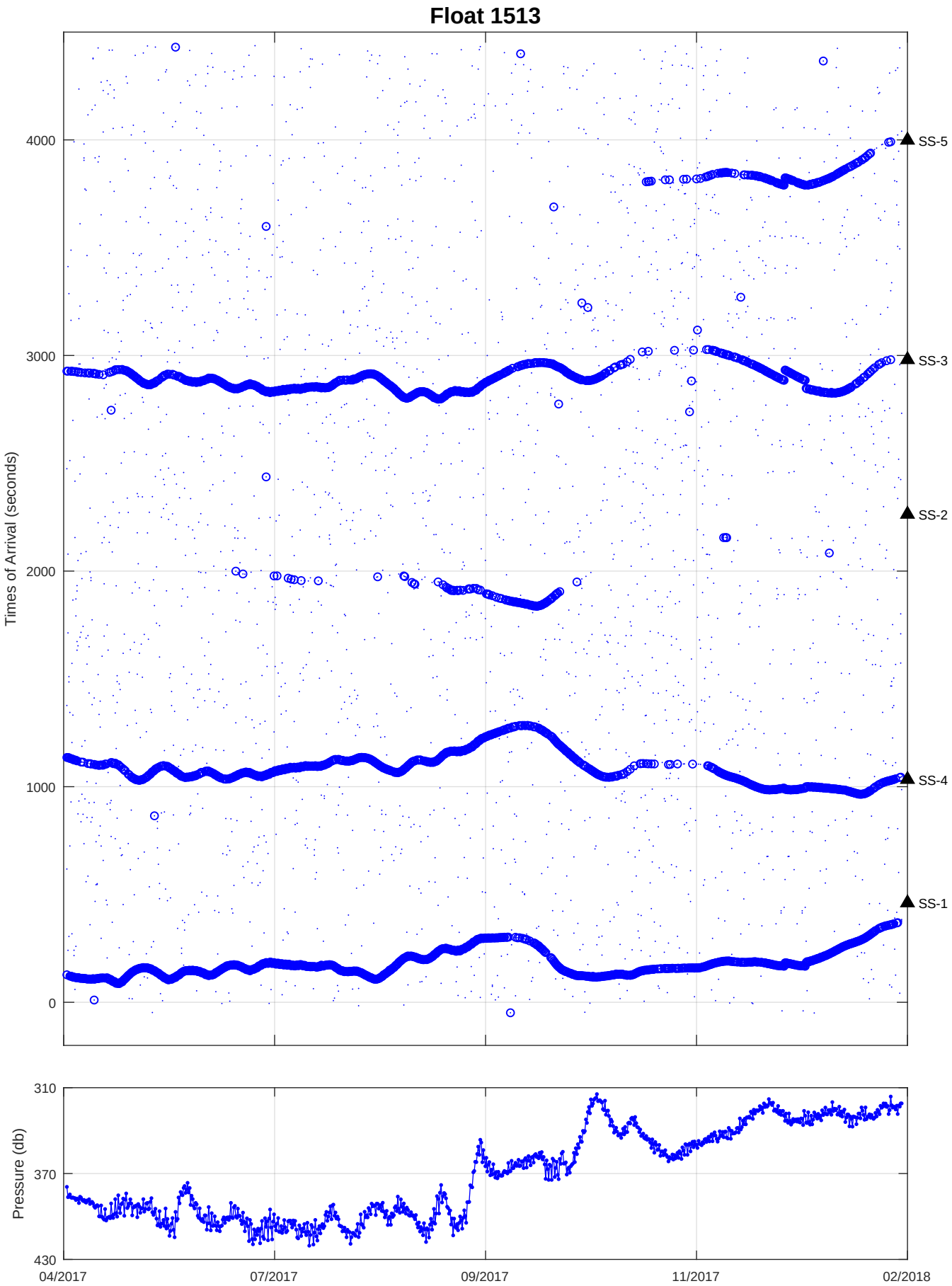

Float 1508
Times of Arrival (seconds)
4000
3000
2000
1000
0
SS-5
SS-3
SS-2
SS-4
SS-1
Pressure (db)
370
390
410
04/2017
05/2017
05/2017
05/2017
05/2017

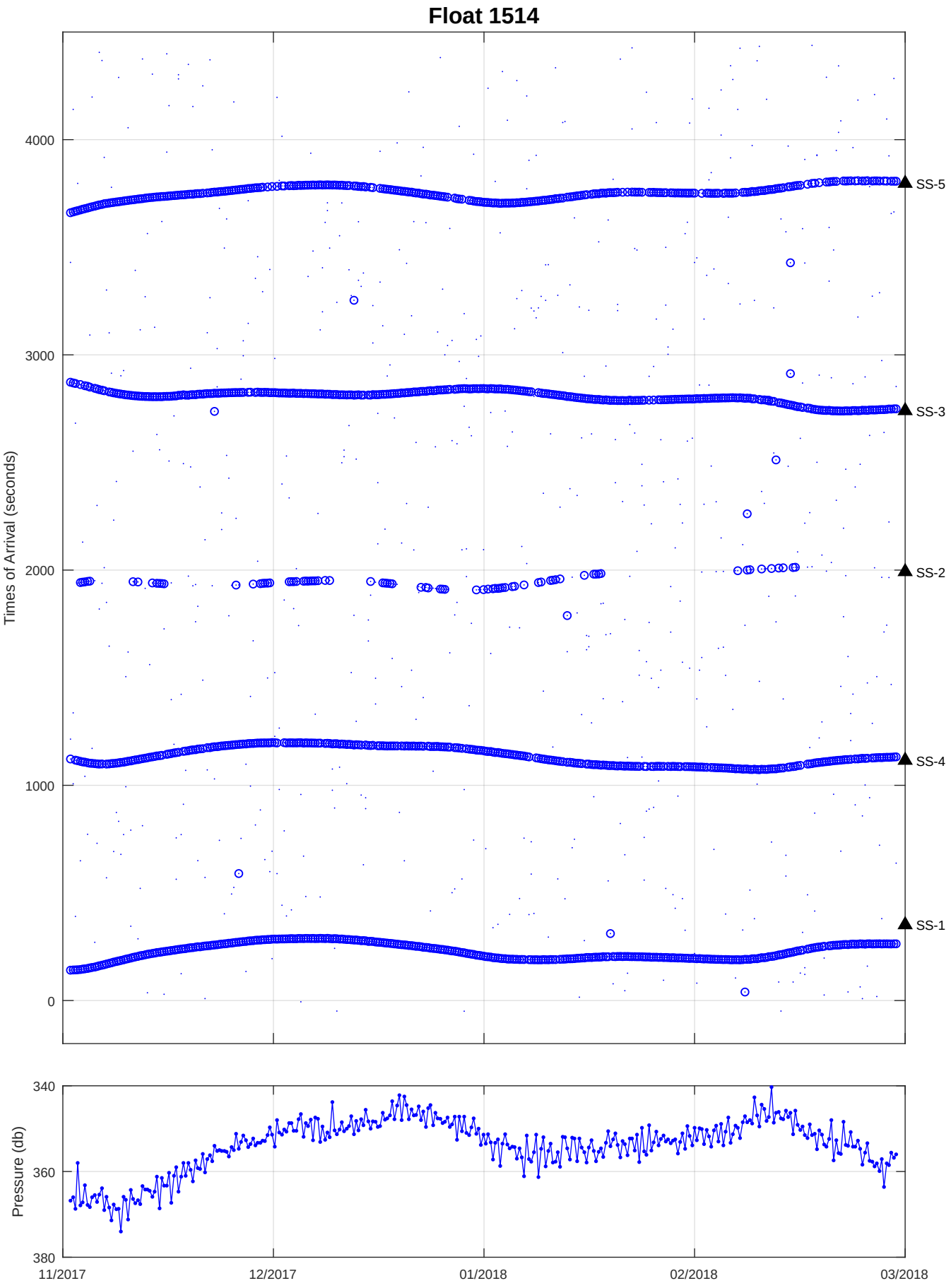

Float 1509
Times of Arrival (seconds)
4000
3000
2000
1000
0
SS-5
SS-3
SS-2
SS-4
SS-1
Pressure (db)
140
215
290
04/2017
07/2017
10/2017
01/2018
04/2018

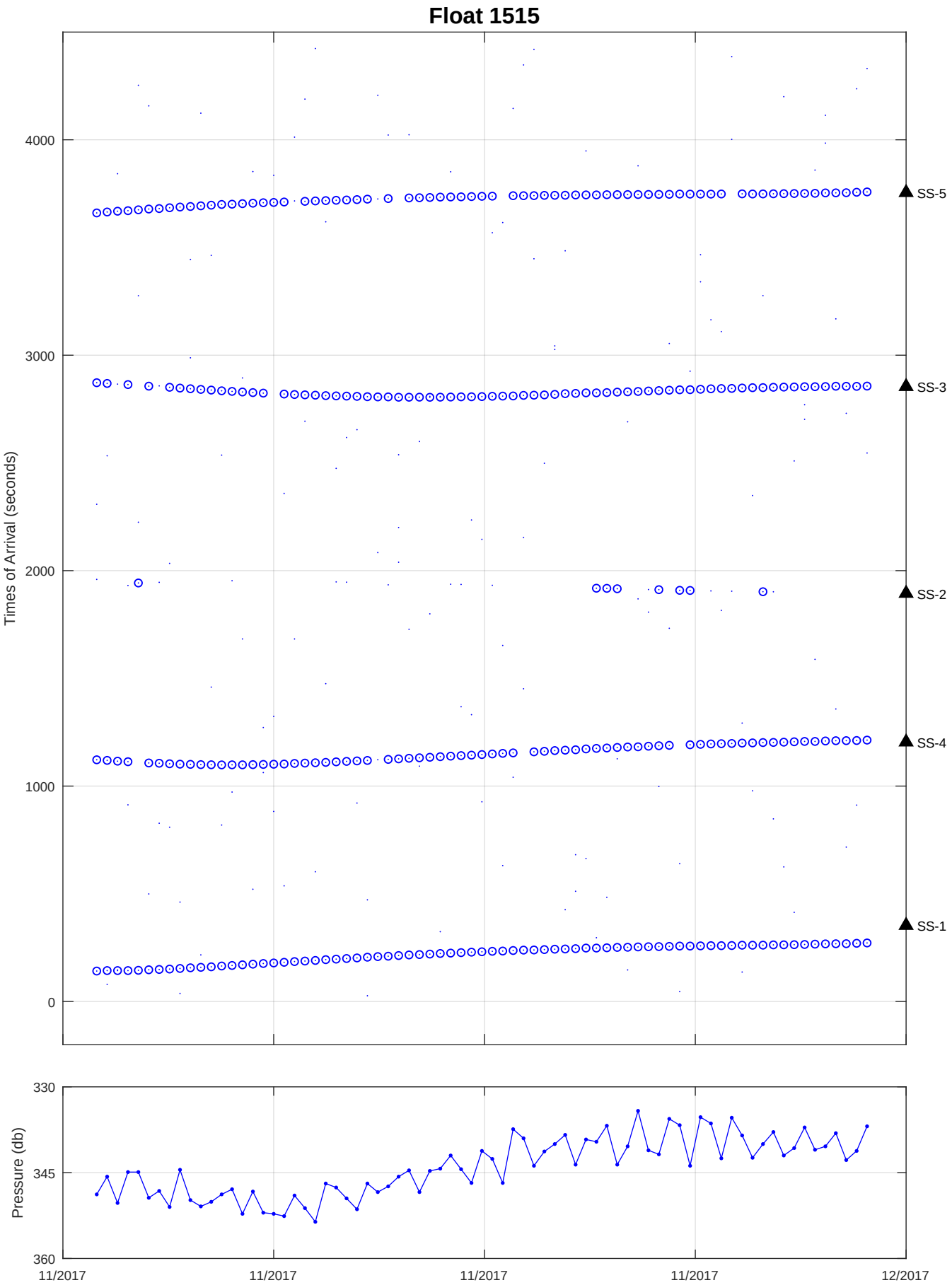

Float 1510
Times of Arrival (seconds)
4000
3000
2000
1000
0
SS-5
SS-3
SS-2
SS-4
SS-1
Pressure (db)
290
335
380
11/2017
02/2018
05/2018
08/2018
11/2018

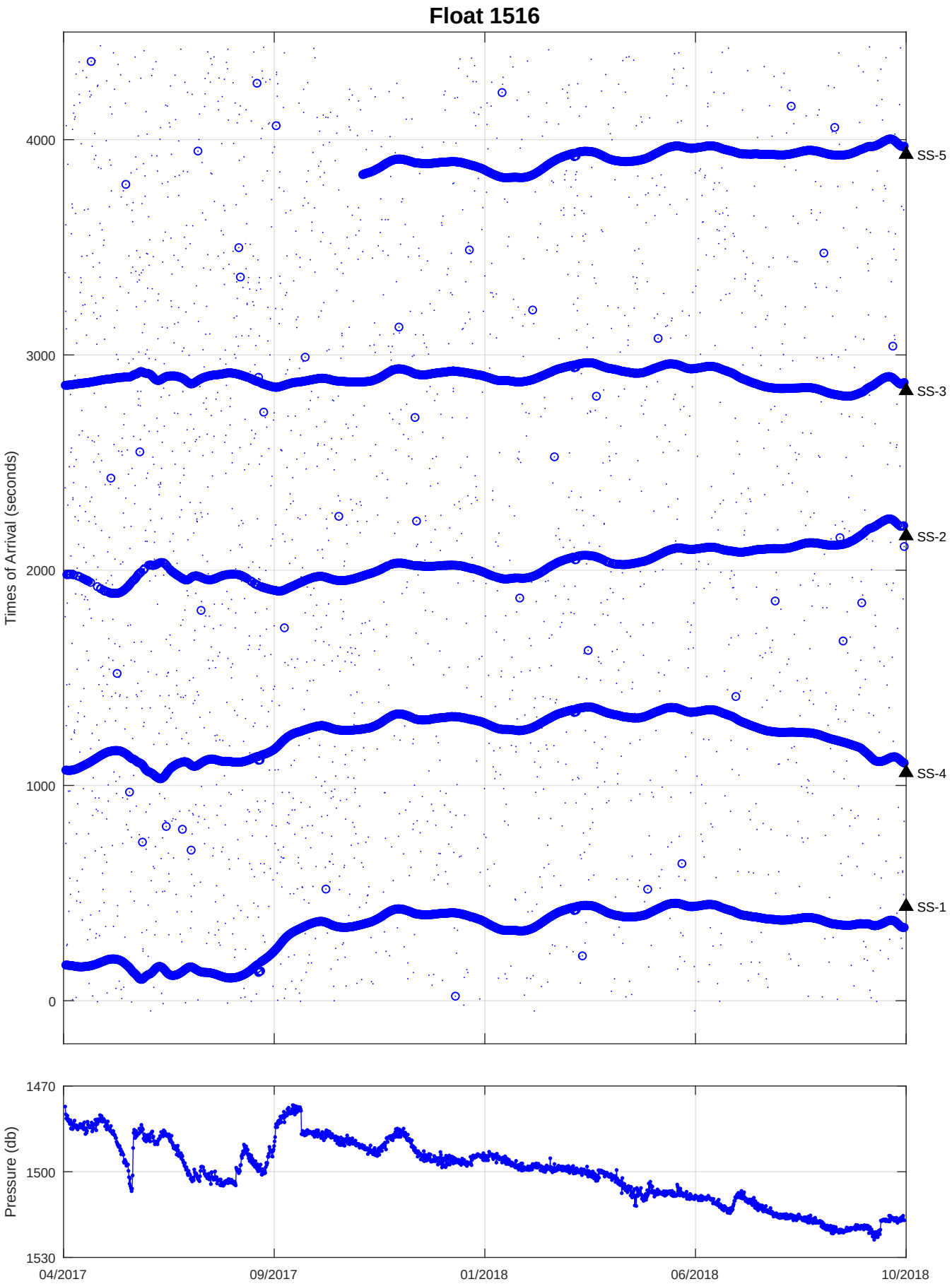

Float 1511
Times of Arrival (seconds)
4000
3000
2000
1000
0
SS-5
SS-3
SS-2
SS-4
SS-1
Pressure (db)
290
335
380
11/2017
02/2018
05/2018
08/2018
11/2018

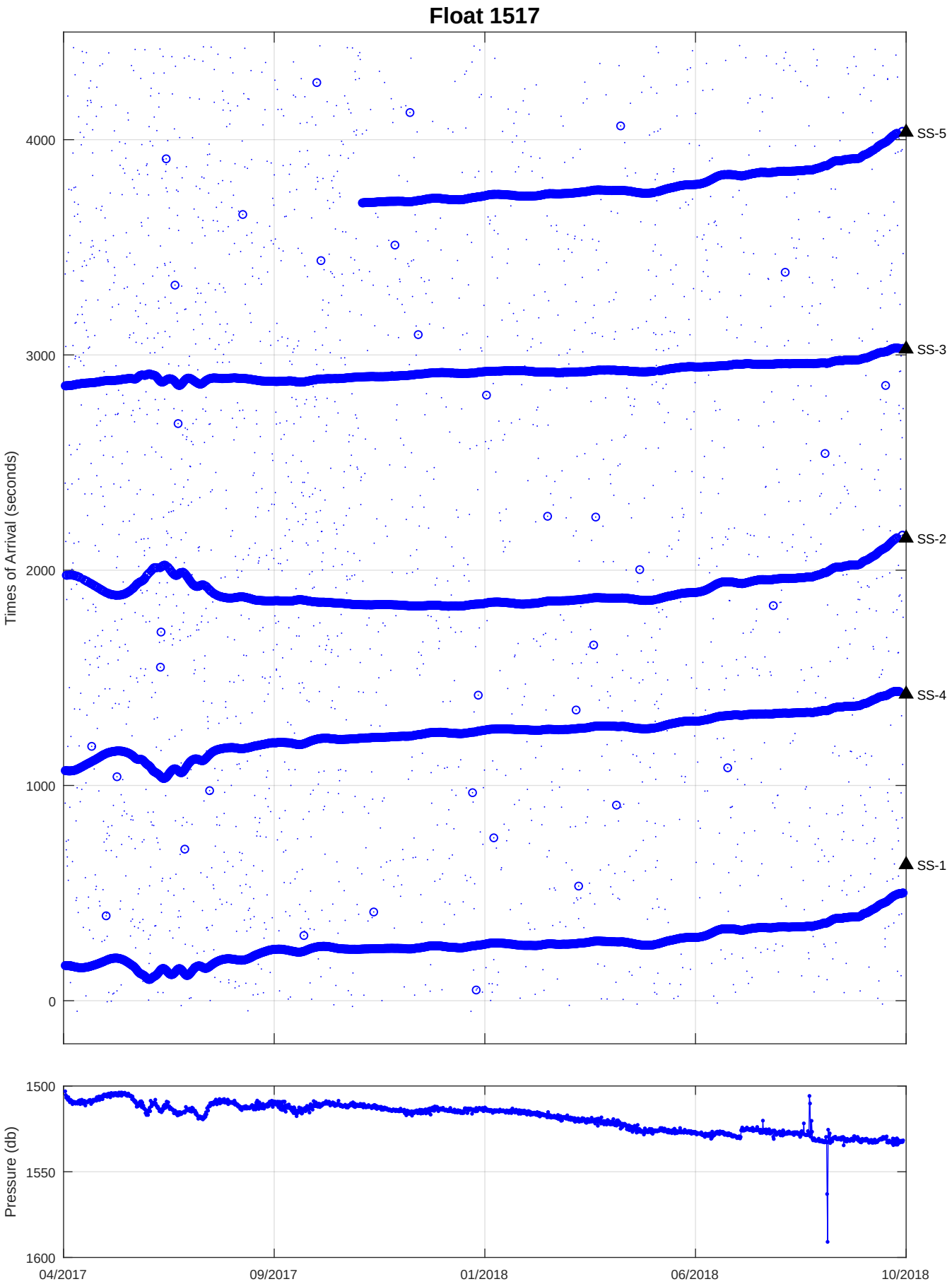

Float 1512
Times of Arrival (seconds)
4000
3000
2000
1000
0
SS-5
SS-3
SS-2
SS-4
SS-1
Pressure (db)
310
355
400
04/2017
06/2017
07/2017
09/2017
10/2017

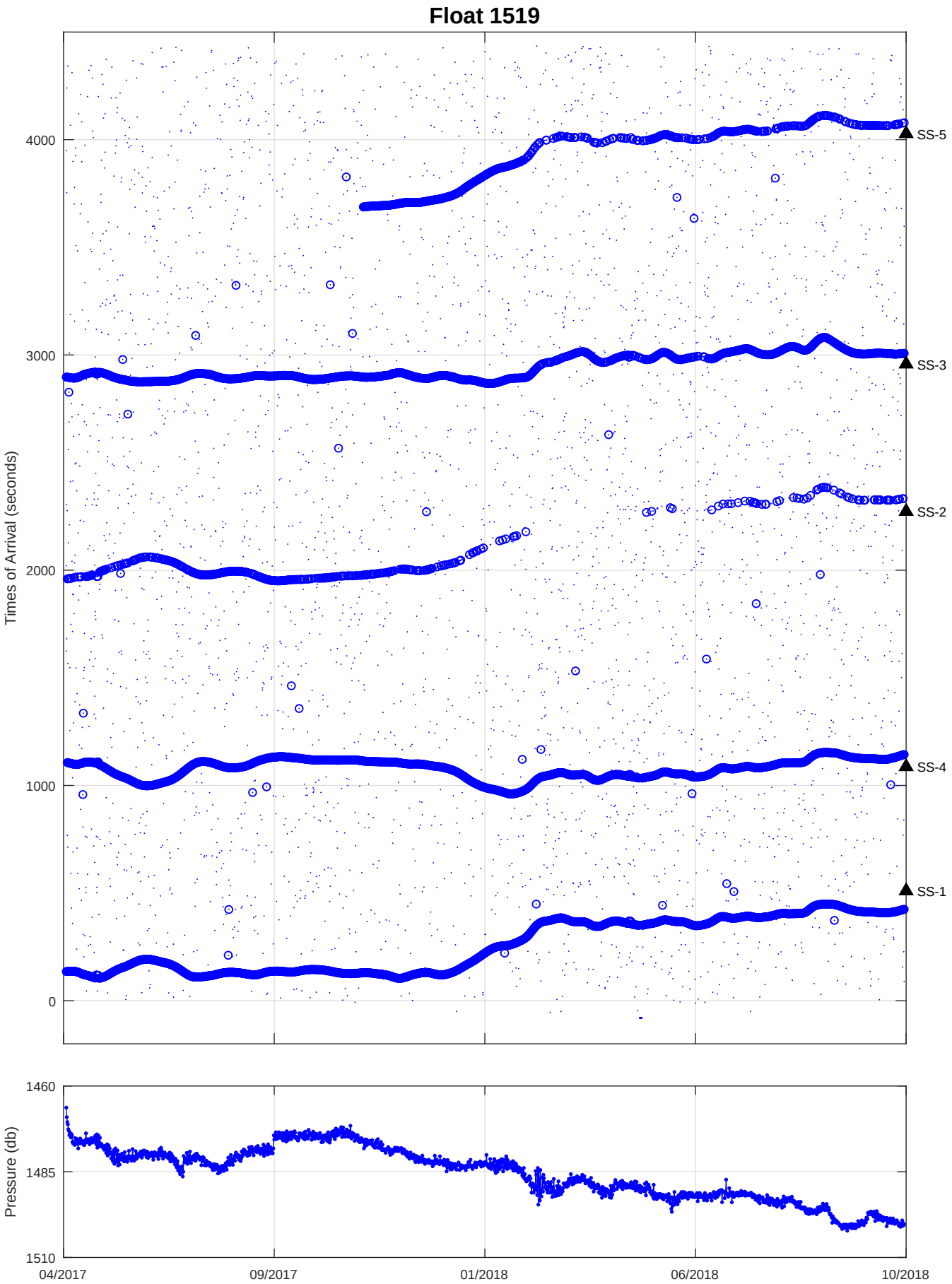

Float 1513
Times of Arrival (seconds)
4000
3000
2000
1000
0
SS-5
SS-3
SS-2
SS-4
SS-1
Pressure (db)
310
370
430
04/2017
07/2017
09/2017
11/2017
02/2018

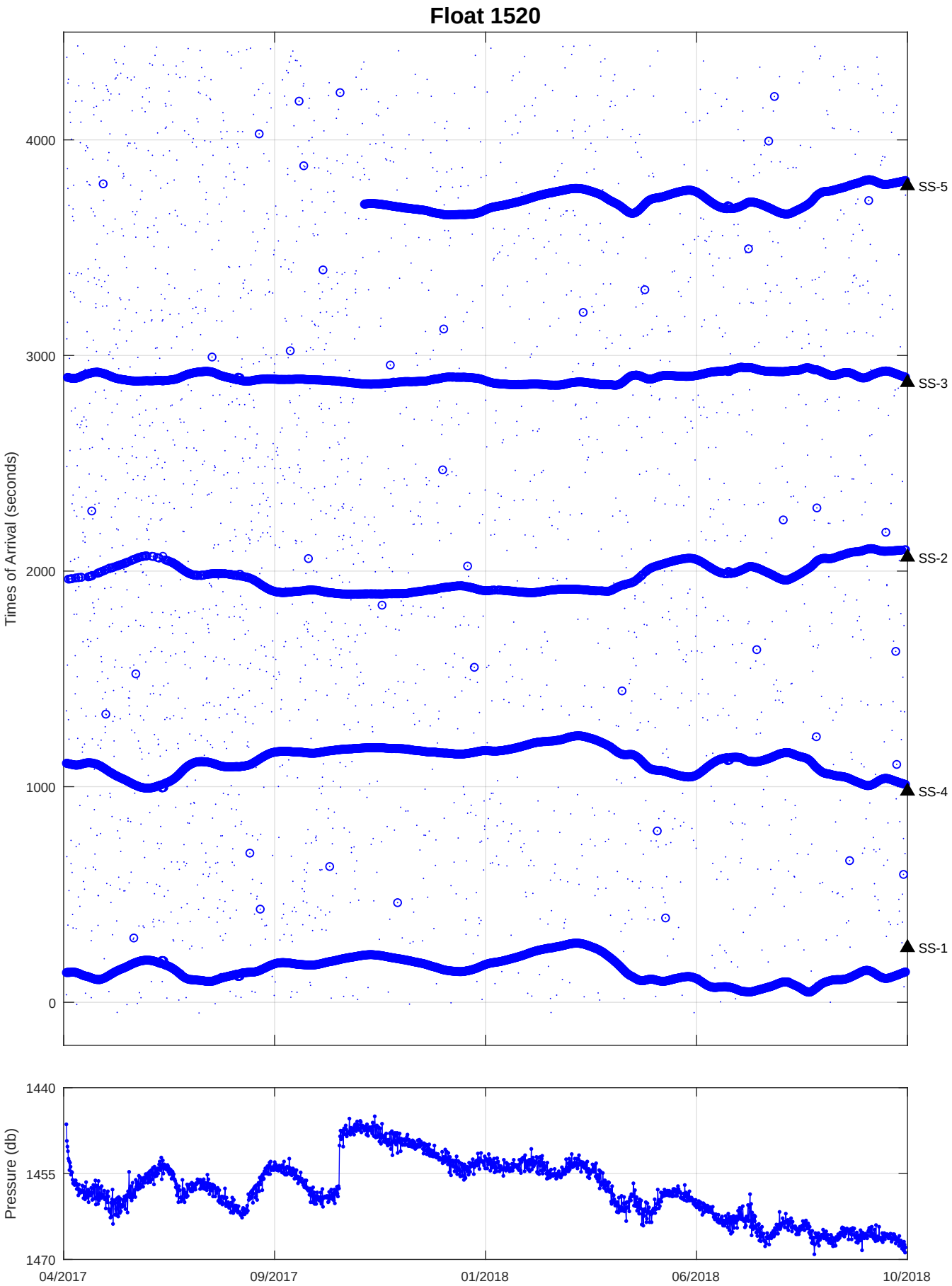

Float 1514
Times of Arrival (seconds)
4000
3000
2000
1000
0
SS-5
SS-3
SS-2
SS-4
SS-1
Pressure (db)
340
360
380
11/2017
12/2017
01/2018
02/2018
03/2018

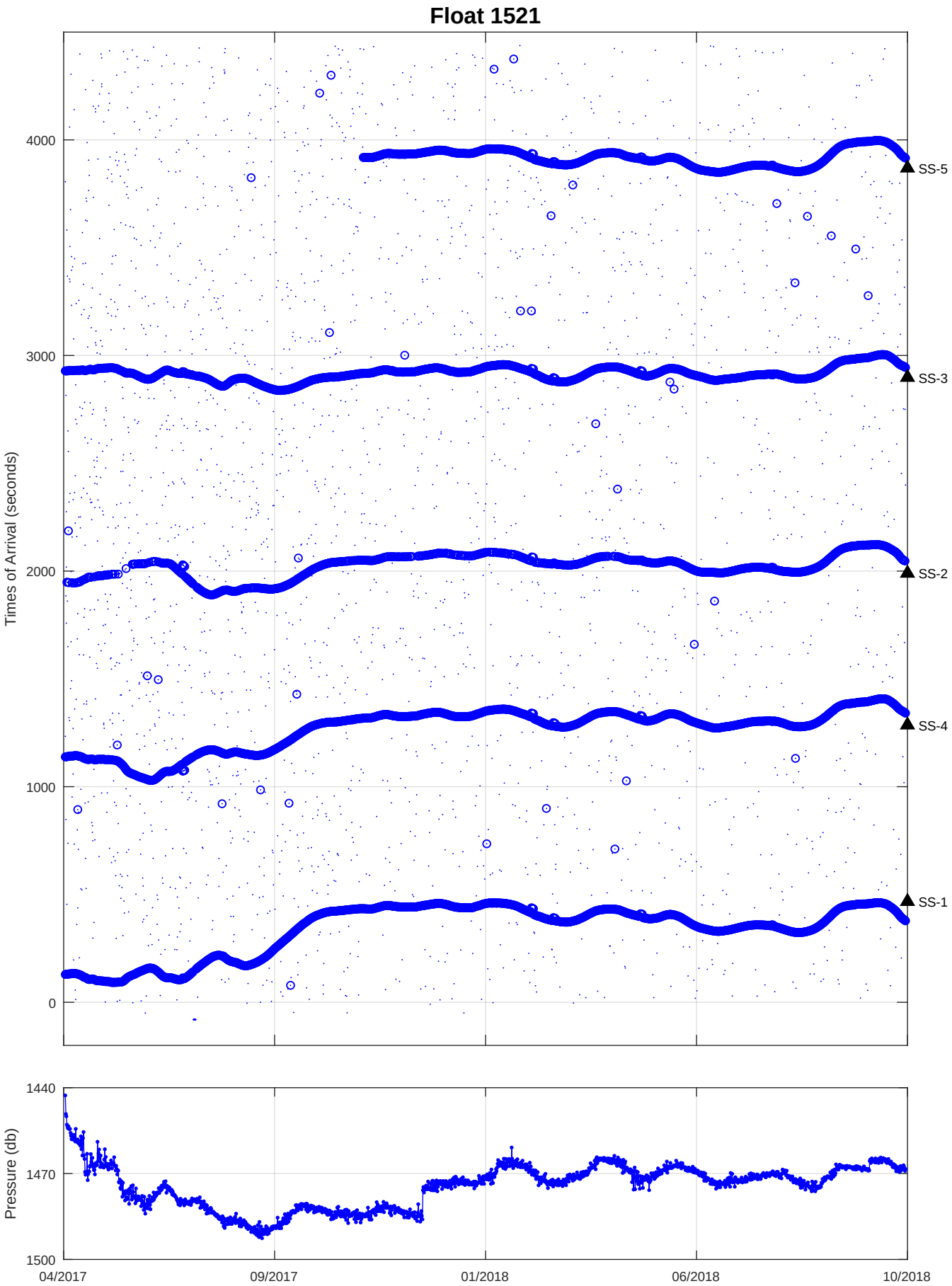

Float 1515
Times of Arrival (seconds)
4000
3000
2000
1000
0
SS-5
SS-3
SS-2
SS-4
SS-1
Pressure (db)
330
345
360
11/2017
11/2017
11/2017
11/2017
12/2017

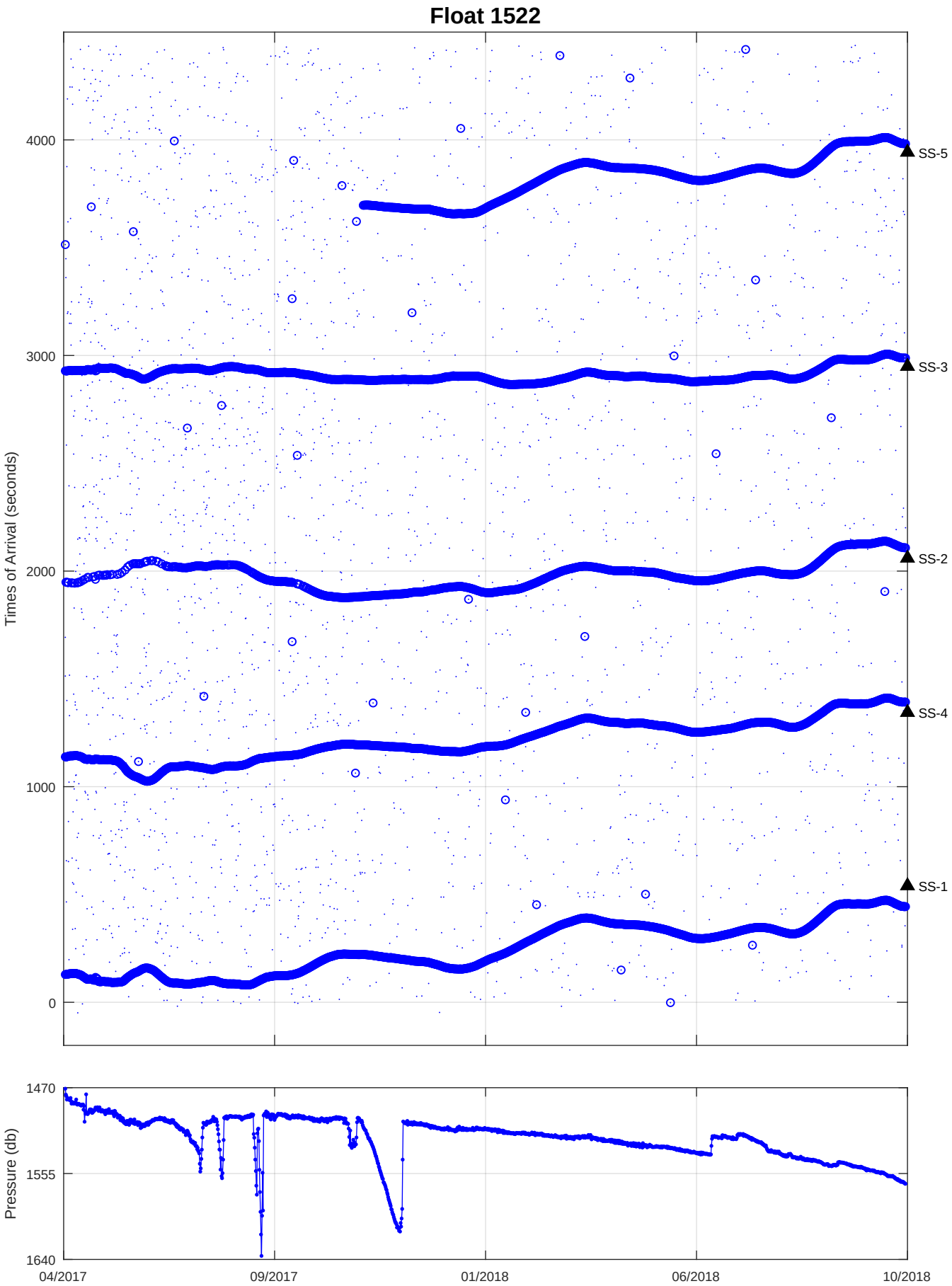

Float 1516
Times of Arrival (seconds)
4000
3000
2000
1000
0
SS-5
SS-3
SS-2
SS-4
SS-1
Pressure (db)
1470
1500
1530
04/2017
09/2017
01/2018
06/2018
10/2018

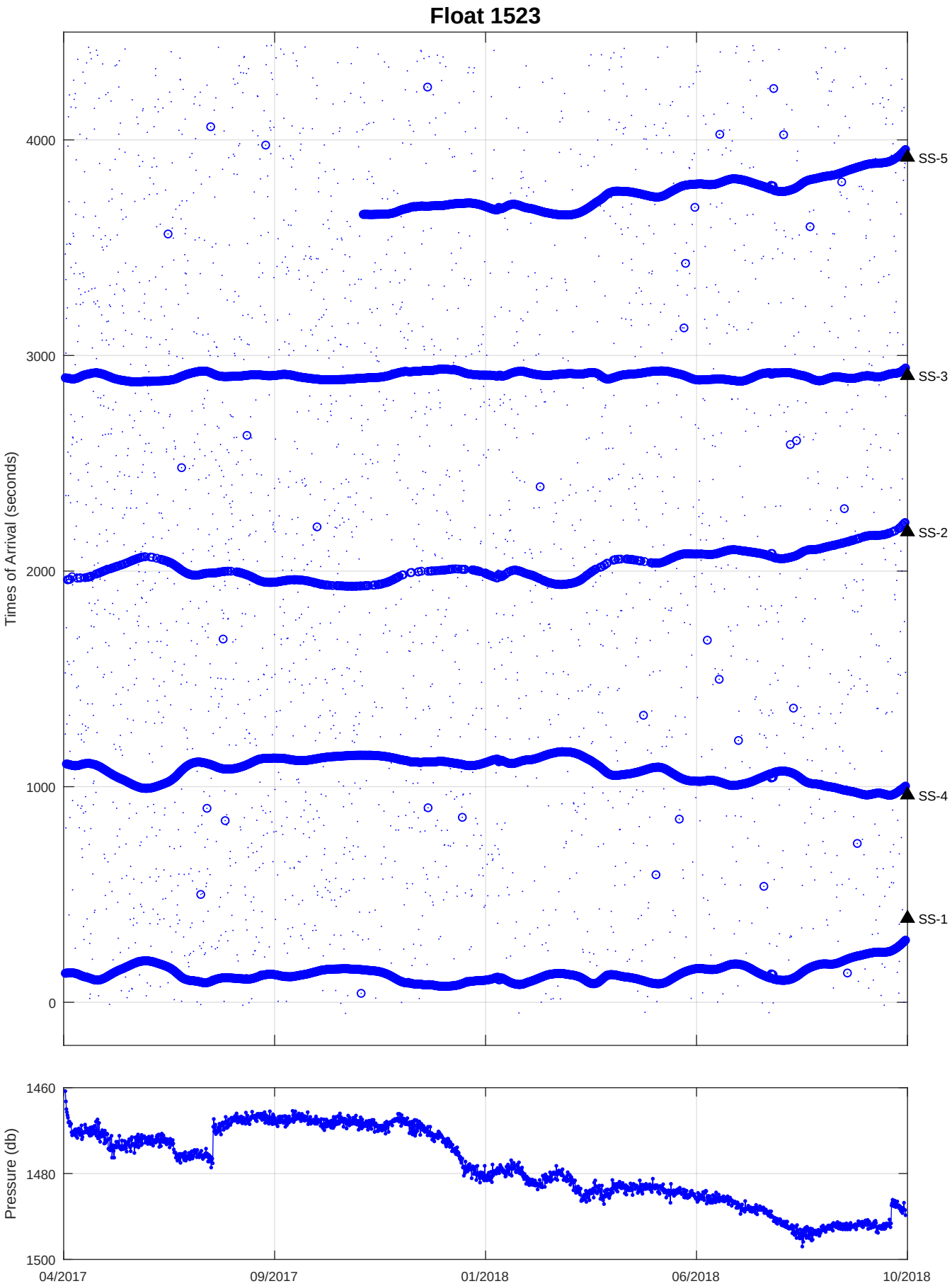

Float 1517
Times of Arrival (seconds)
4000
3000
2000
1000
0
SS-5
SS-3
SS-2
SS-4
SS-1
Pressure (db)
1500
1550
1600
04/2017
09/2017
01/2018
06/2018
10/2018

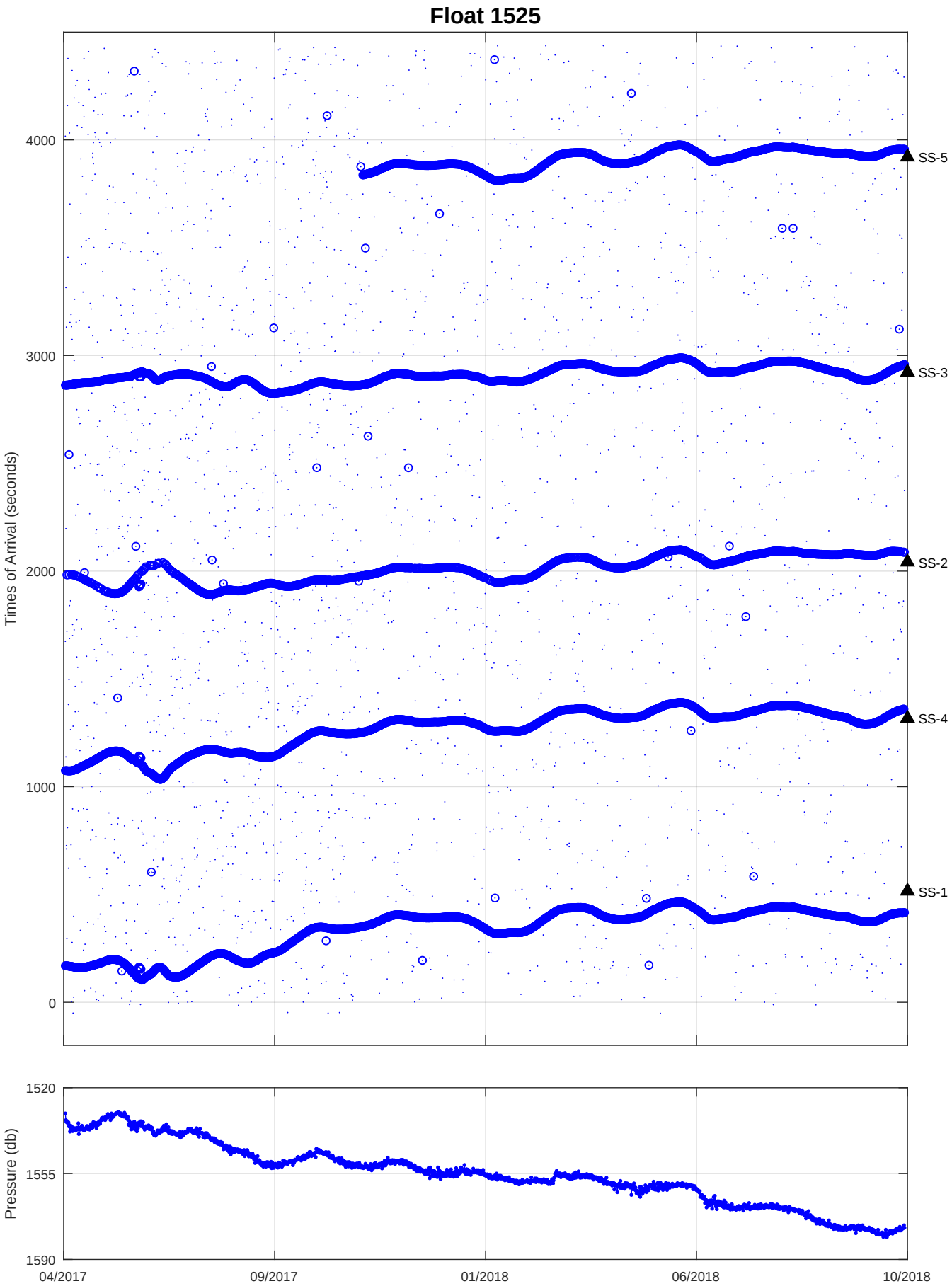

Float 1519
Times of Arrival (seconds)
4000
3000
2000
1000
0
SS-5
SS-3
SS-2
SS-4
SS-1
Pressure (db)
1460
1485
1510
04/2017
09/2017
01/2018
06/2018
10/2018

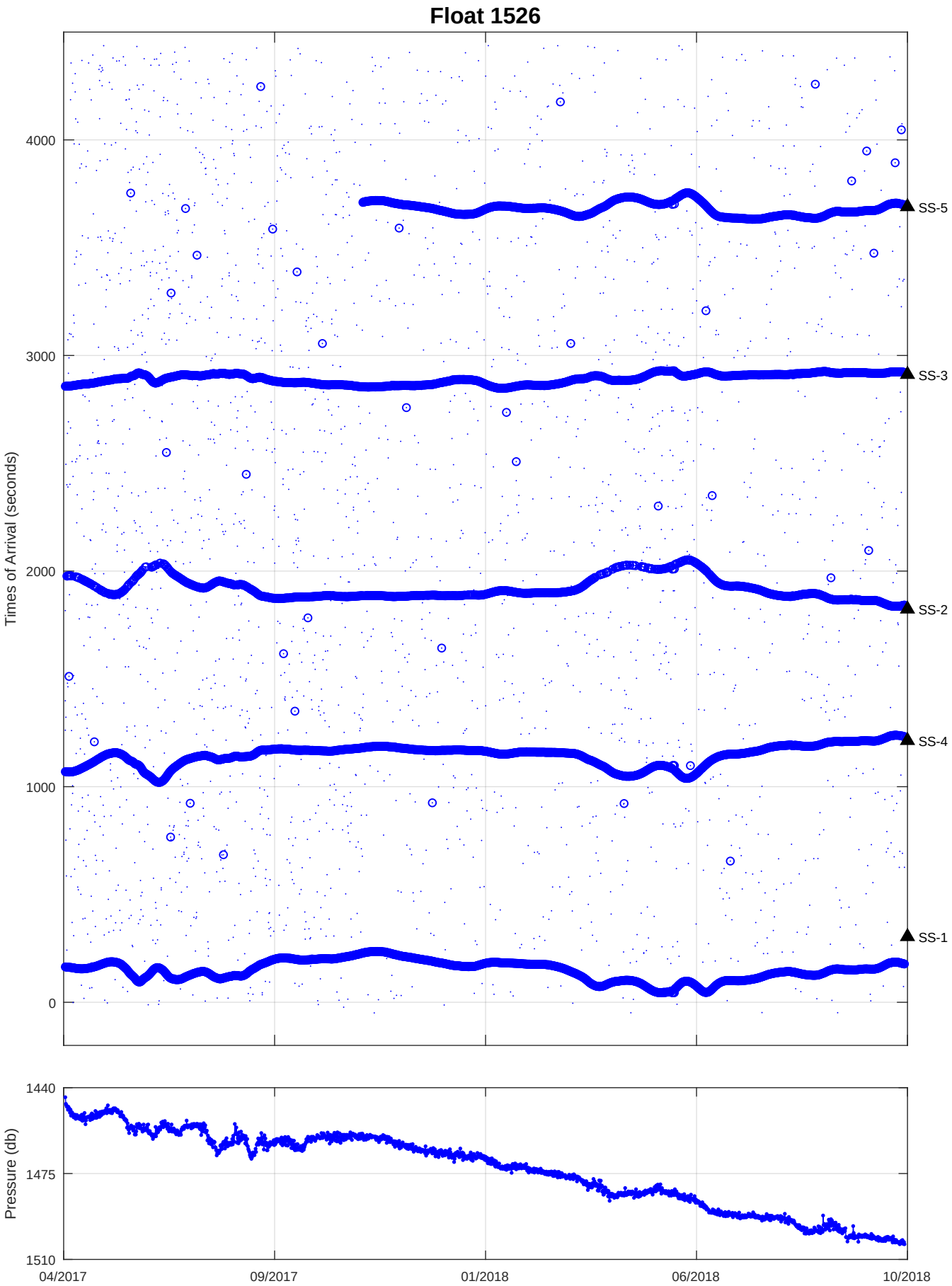

Float 1520
Times of Arrival (seconds)
4000
3000
2000
1000
0
SS-5
SS-3
SS-2
SS-4
SS-1
Pressure (db)
1440
1455
1470
04/2017
09/2017
01/2018
06/2018
10/2018

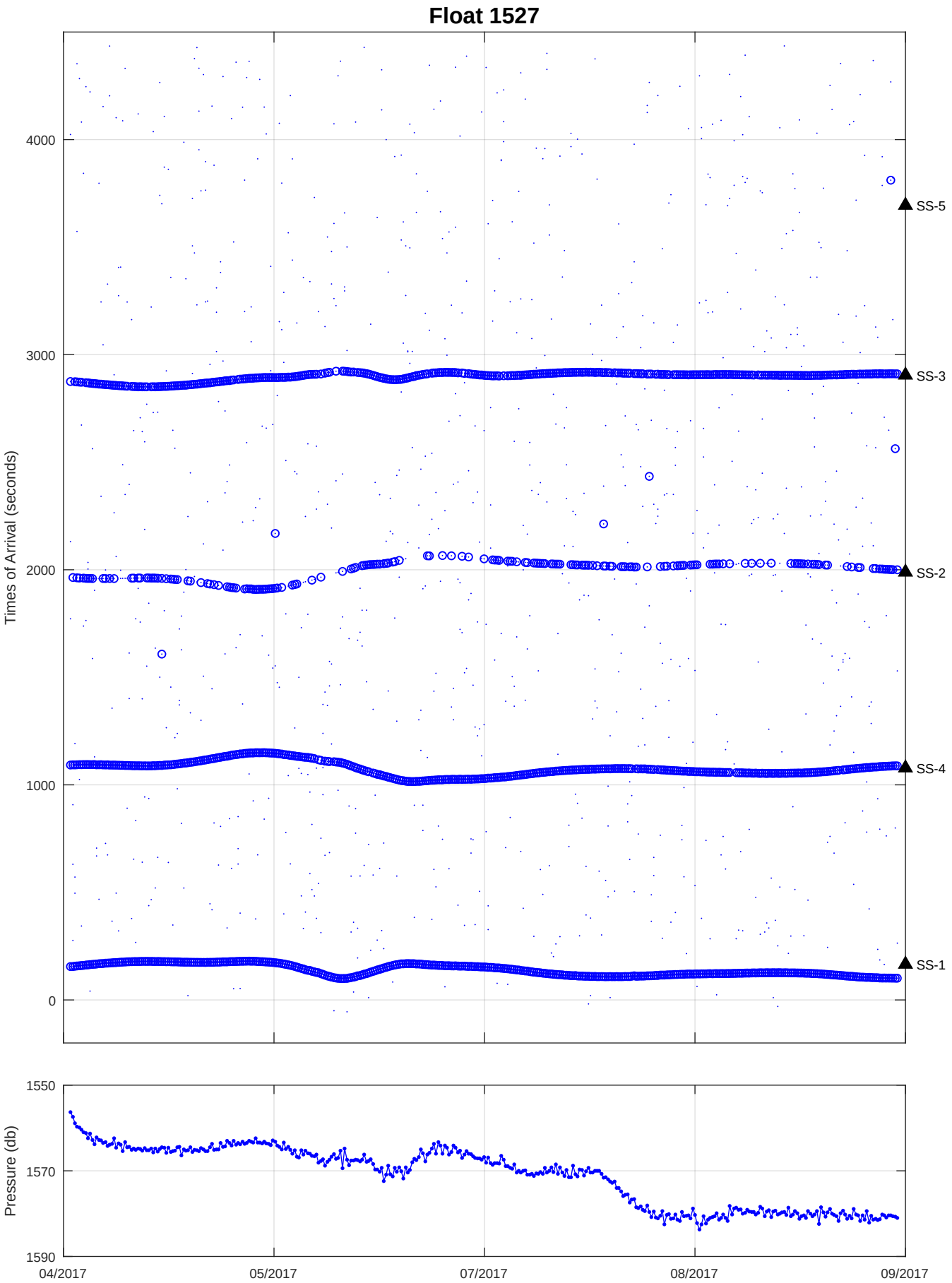

Float 1521
Times of Arrival (seconds)
4000
3000
2000
1000
0
SS-5
SS-3
SS-2
SS-4
SS-1
Pressure (db)
1440
1470
1500
04/2017
09/2017
01/2018
06/2018
10/2018

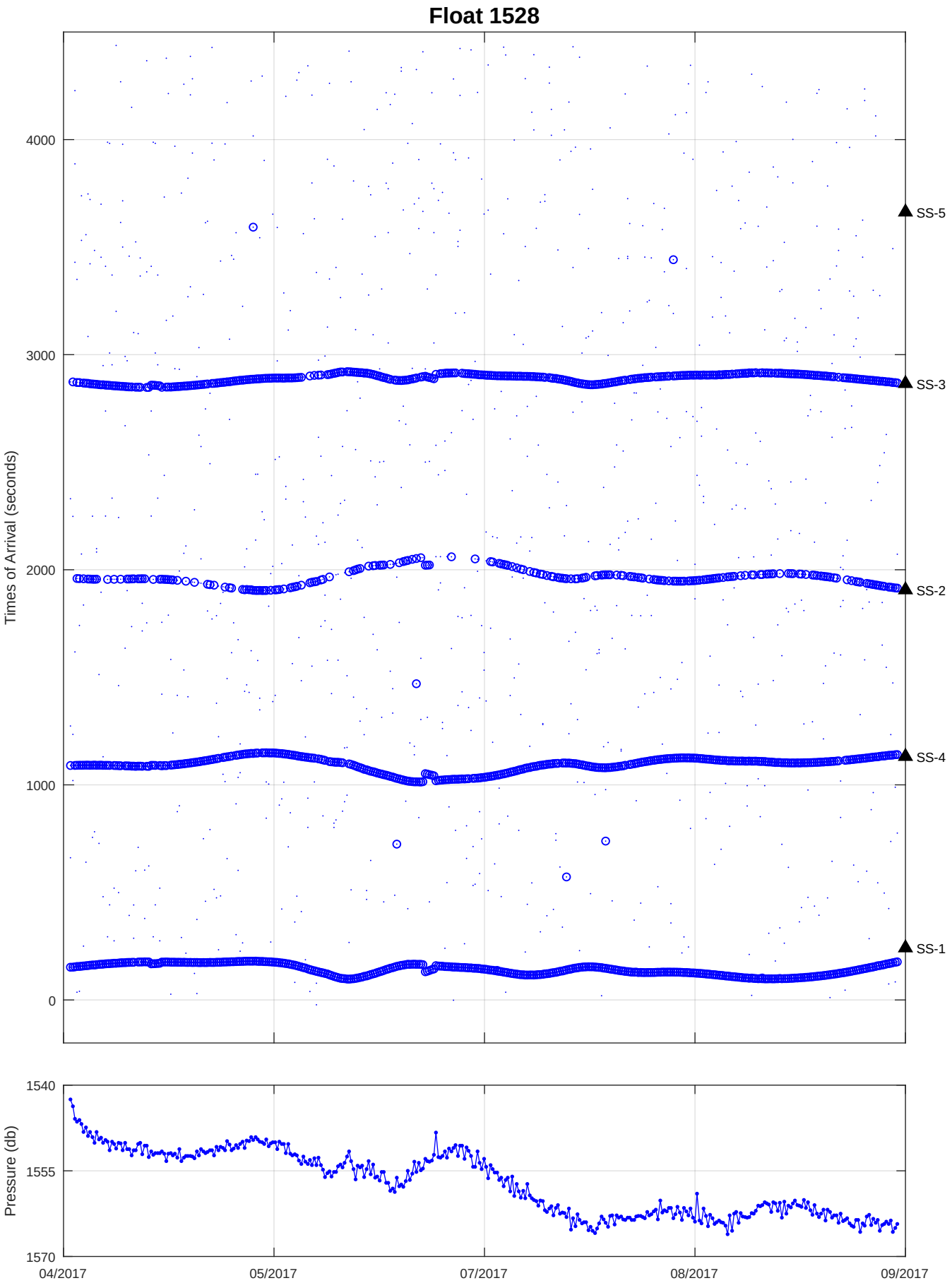

Float 1522
Times of Arrival (seconds)
4000
3000
2000
1000
0
SS-5
SS-3
SS-2
SS-4
SS-1
Pressure (db)
1470
1555
1640
04/2017
09/2017
01/2018
06/2018
10/2018

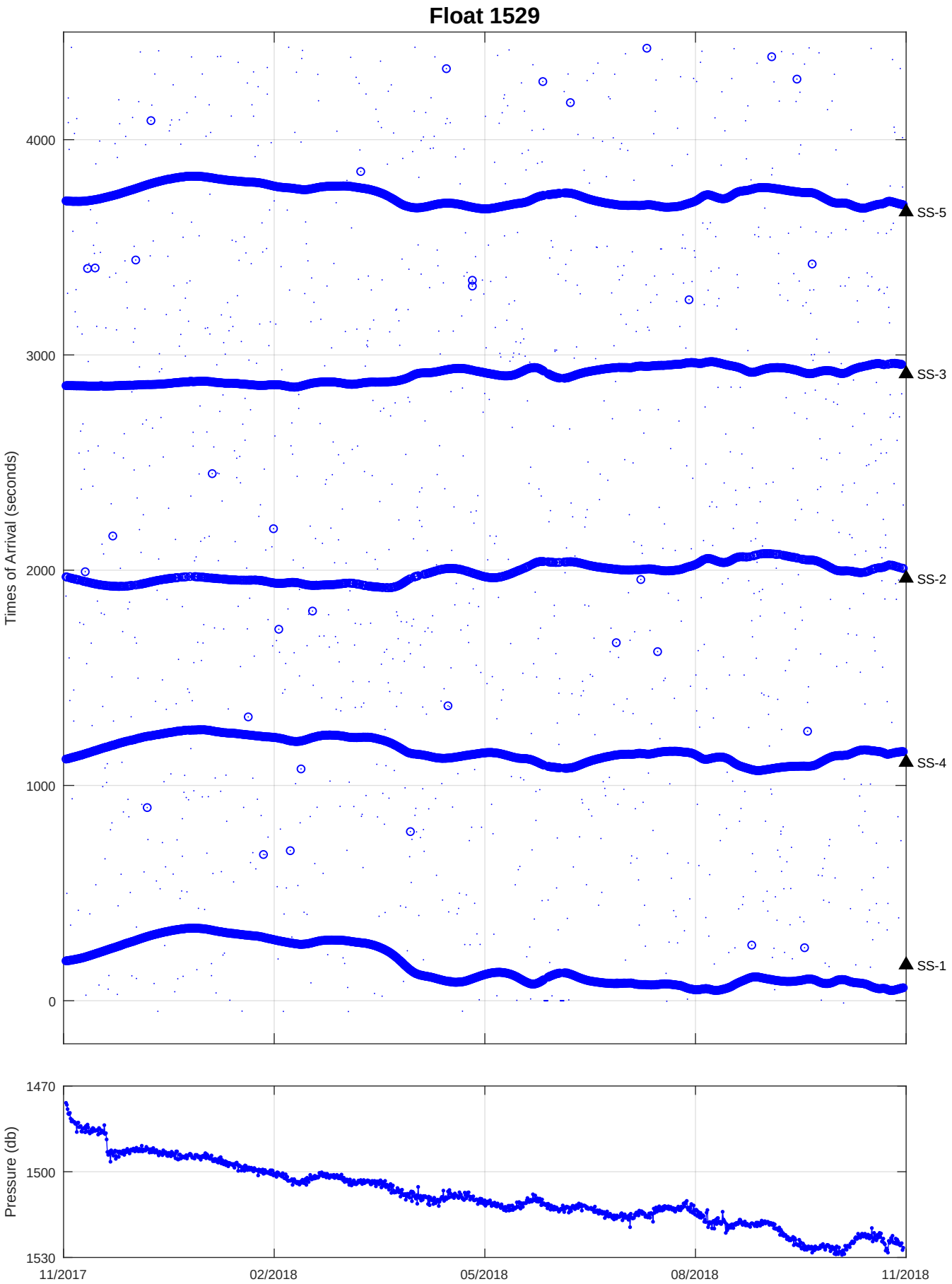

Float 1523
Times of Arrival (seconds)
4000
3000
2000
1000
0
SS-5
SS-3
SS-2
SS-4
SS-1
Pressure (db)
1460
1480
1500
04/2017
09/2017
01/2018
06/2018
10/2018

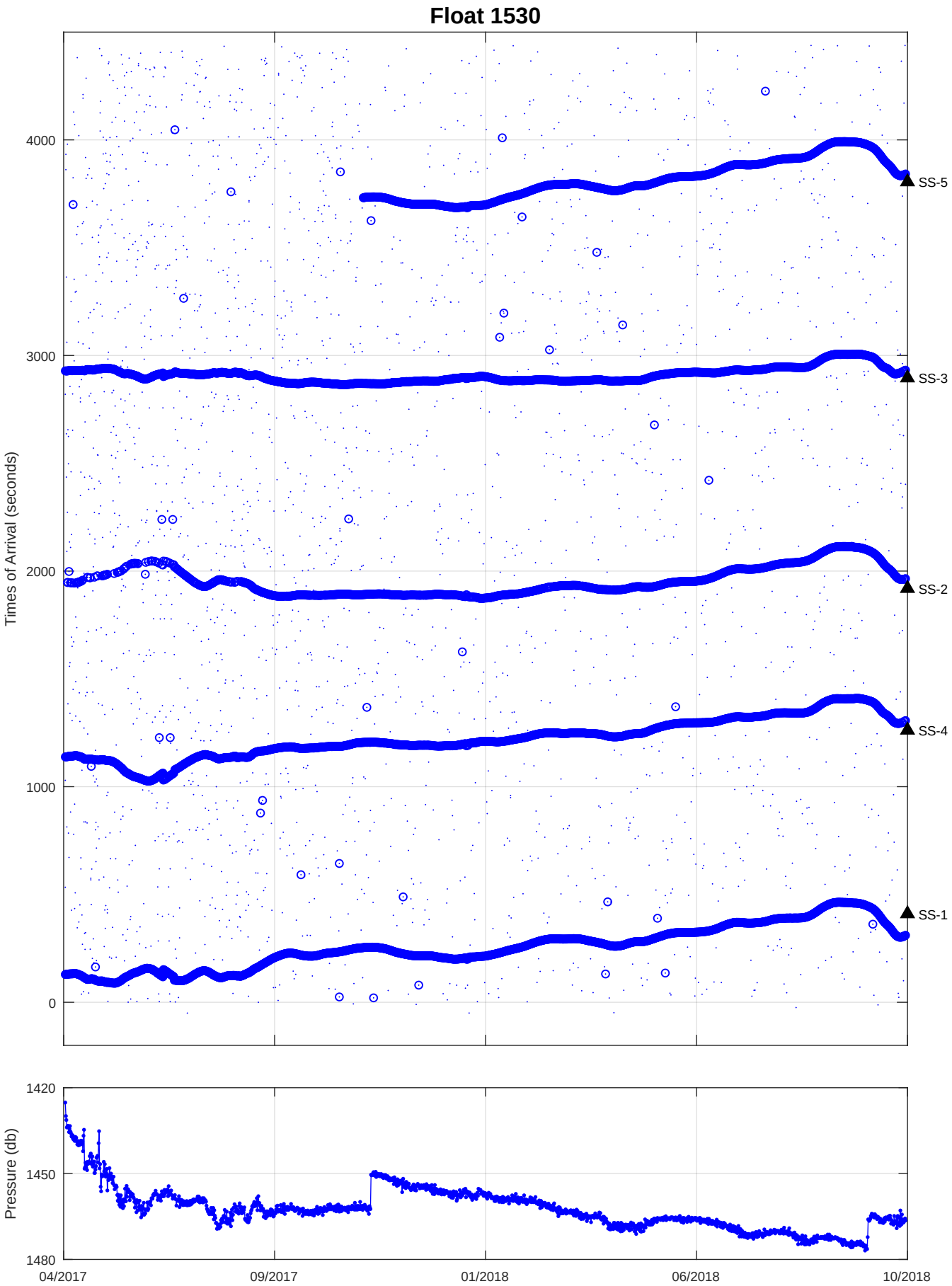

Float 1525
Times of Arrival (seconds)
4000
3000
2000
1000
0
SS-5
SS-3
SS-2
SS-4
SS-1
Pressure (db)
1520
1555
1590
04/2017
09/2017
01/2018
06/2018
10/2018


Float 1526
Times of Arrival (seconds)
4000
3000
2000
1000
0
SS-5
SS-3
SS-2
SS-4
SS-1
Pressure (db)
1440
1475
1510
04/2017
09/2017
01/2018
06/2018
10/2018

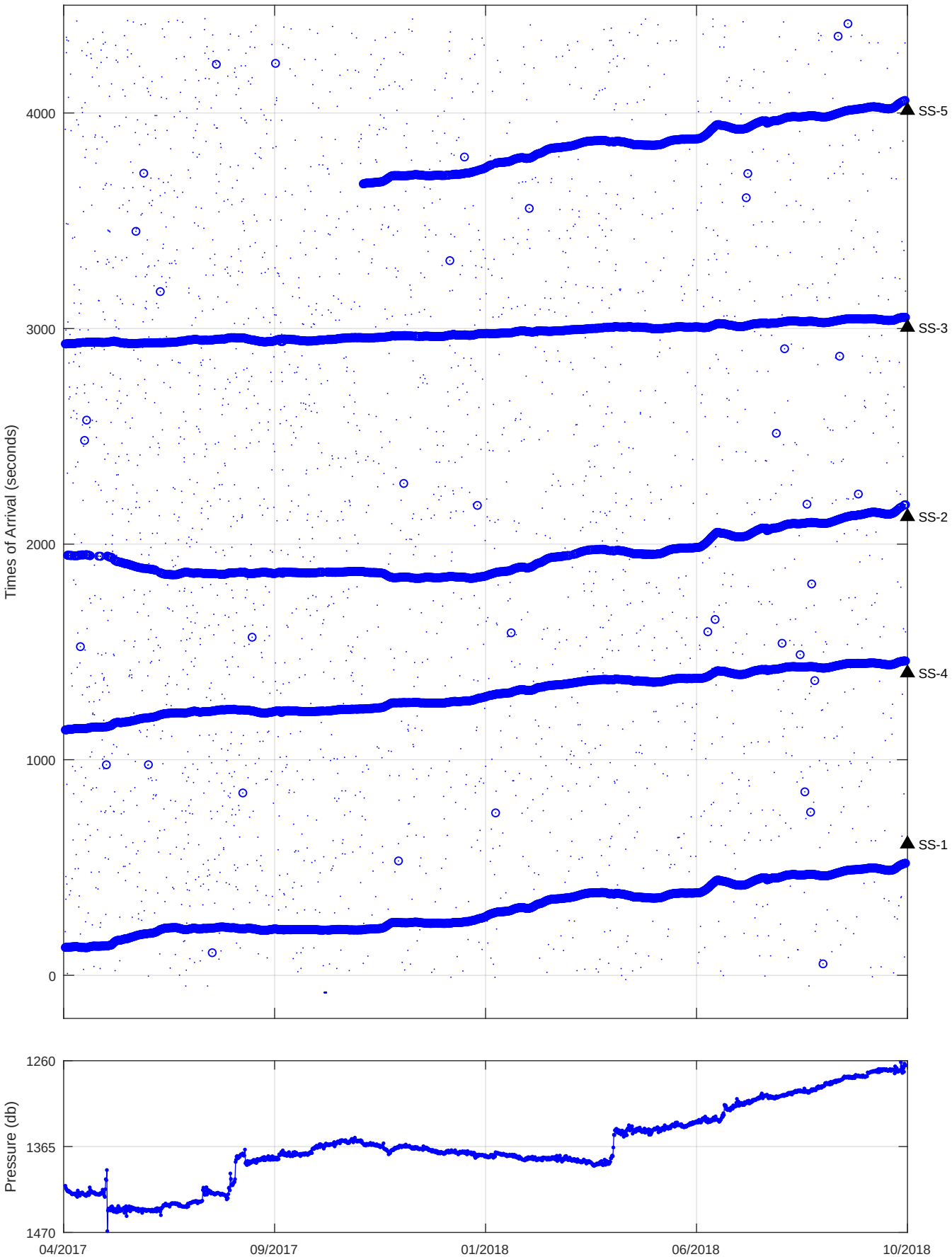

Float 1527
Times of Arrival (seconds)
4000
3000
2000
1000
0
SS-5
SS-3
SS-2
SS-4
SS-1
Pressure (db)
1550
1570
1590
04/2017
05/2017
07/2017
08/2017
09/2017

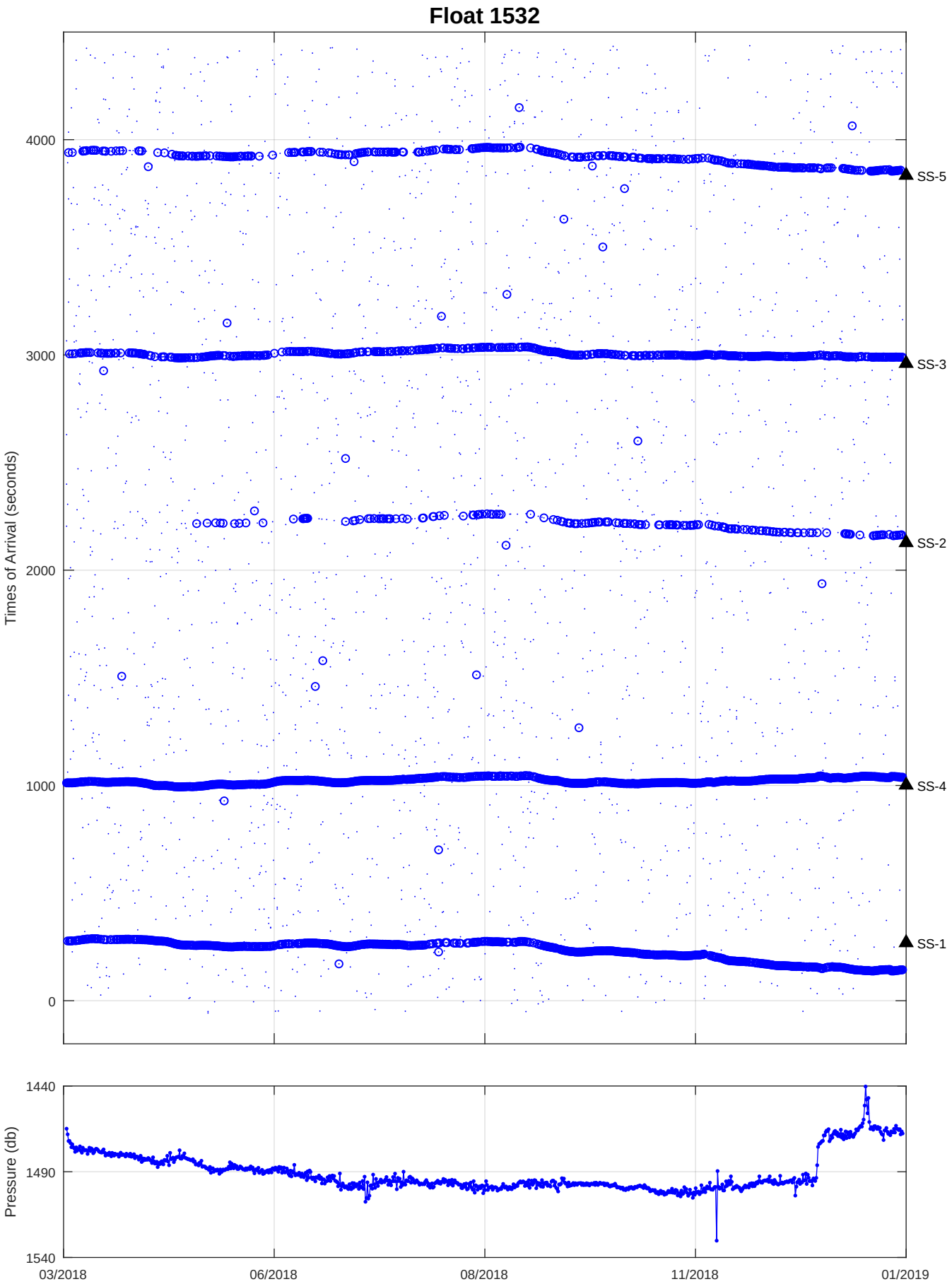

Float 1528
Times of Arrival (seconds)
4000
3000
2000
1000
0
SS-5
SS-3
SS-2
SS-4
SS-1
Pressure (db)
1540
1555
1570
04/2017
05/2017
07/2017
08/2017
09/2017

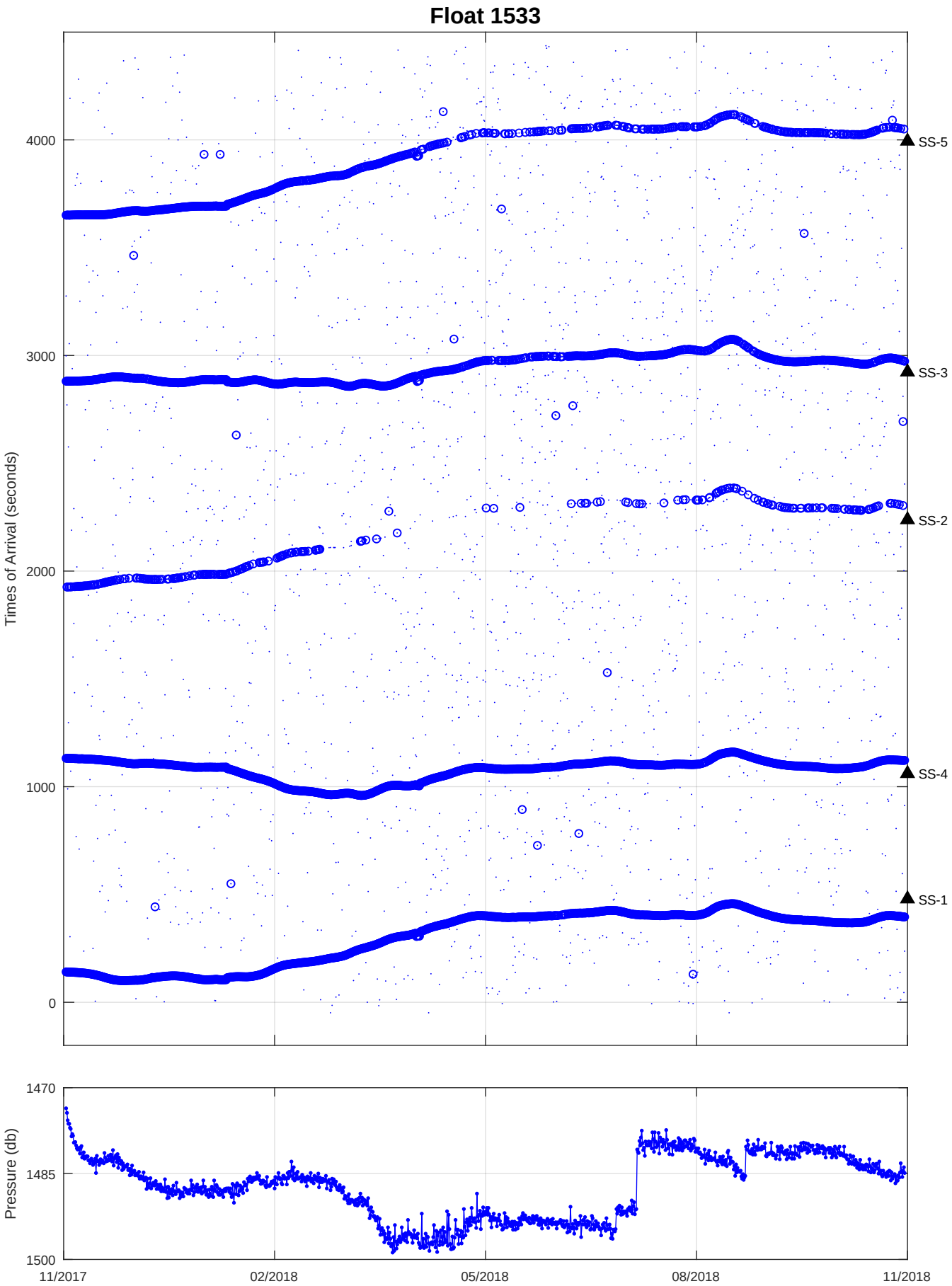

Float 1529
Times of Arrival (seconds)
4000
3000
2000
1000
0
SS-5
SS-3
SS-2
SS-4
SS-1
Pressure (db)
1470
1500
1530
11/2017
02/2018
05/2018
08/2018
11/2018

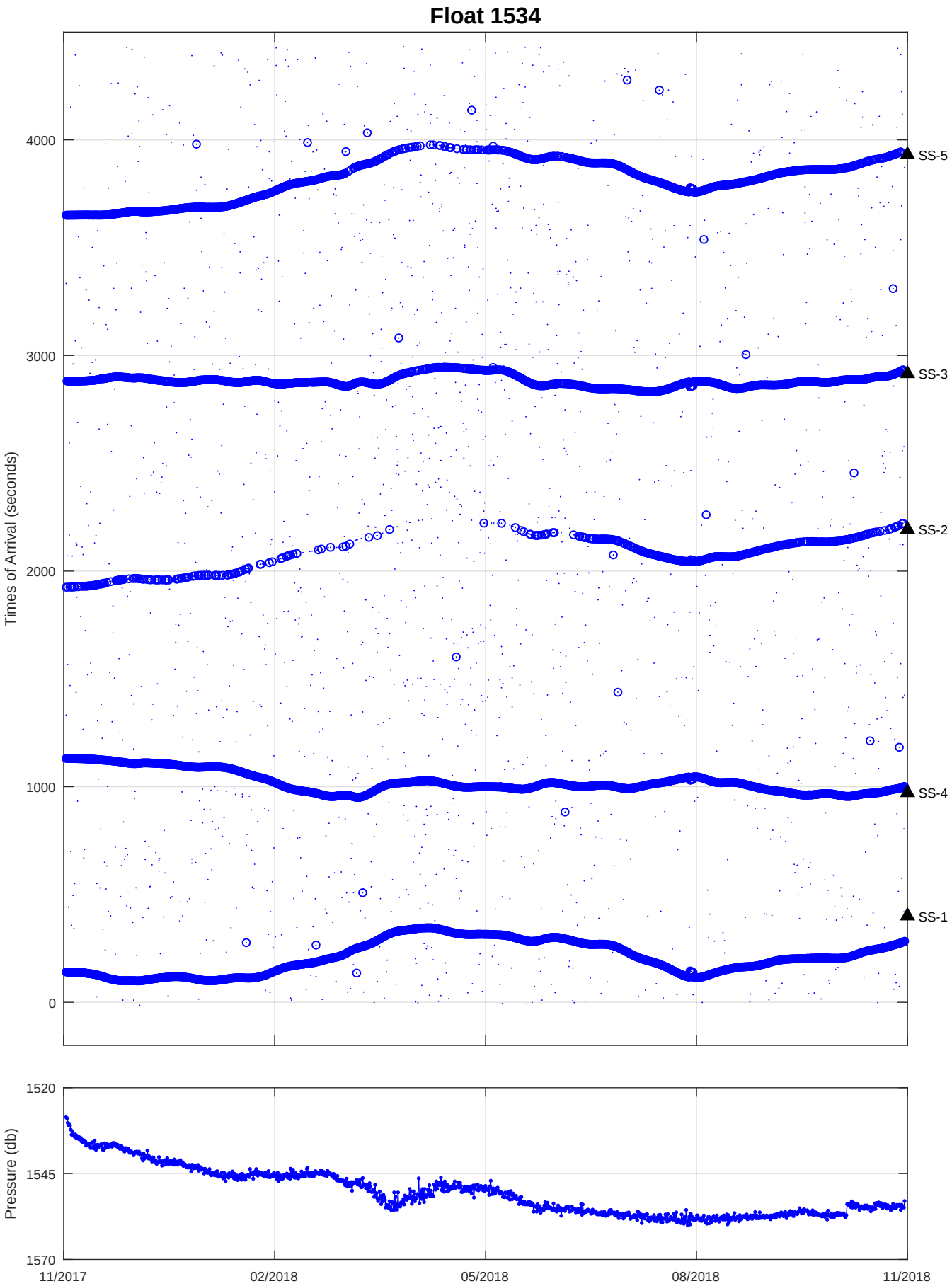

Float 1530
Times of Arrival (seconds)
4000
3000
2000
1000
0
SS-5
SS-3
SS-2
SS-4
SS-1
Pressure (db)
1420
1450
1480
04/2017
09/2017
01/2018
06/2018
10/2018

Float 1531

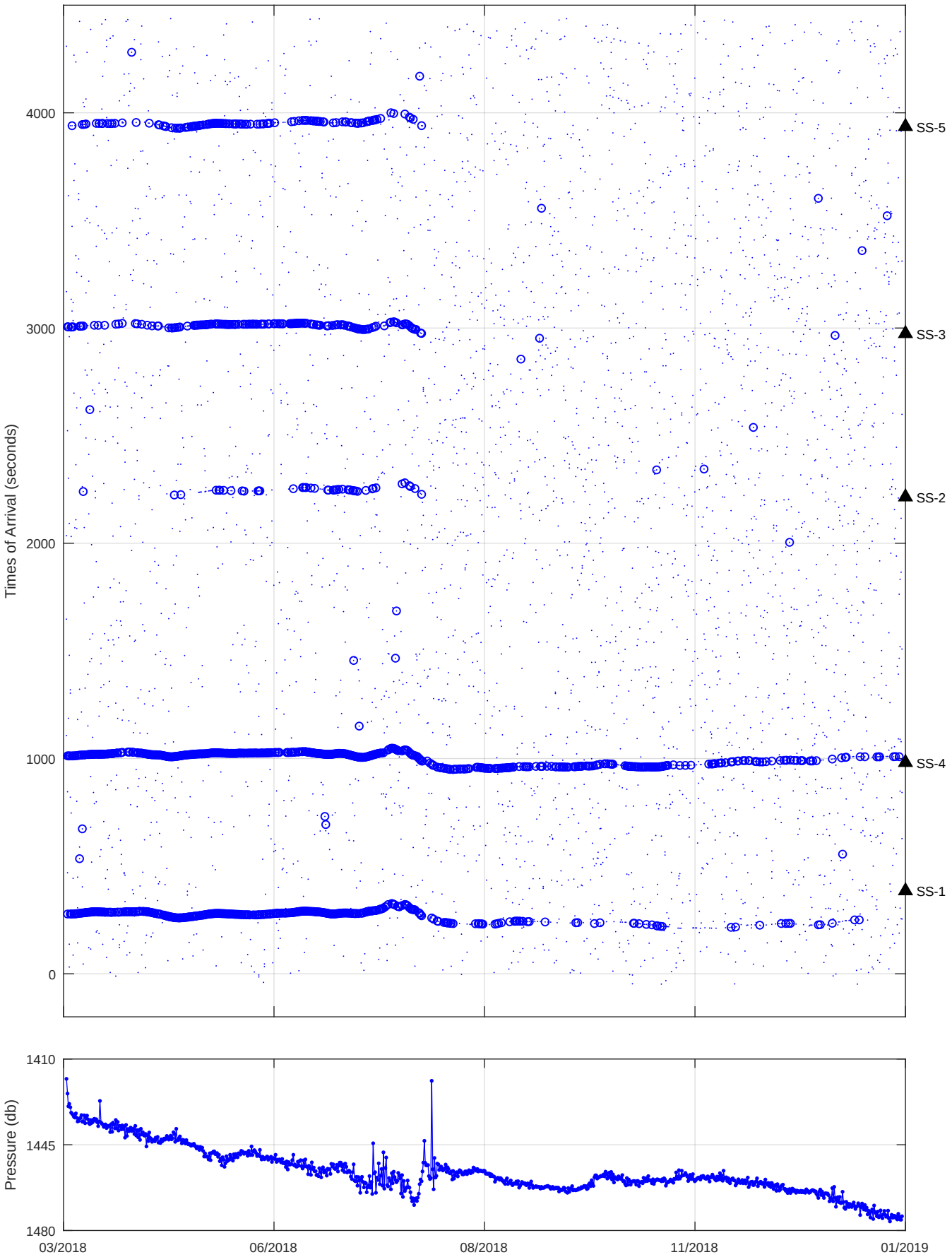

Times of Arrival (seconds)
4000
3000
2000
1000
0
SS-5
SS-3
SS-2
SS-4
SS-1
Pressure (db)
1260
1365
1470
04/2017
09/2017
01/2018
06/2018
10/2018

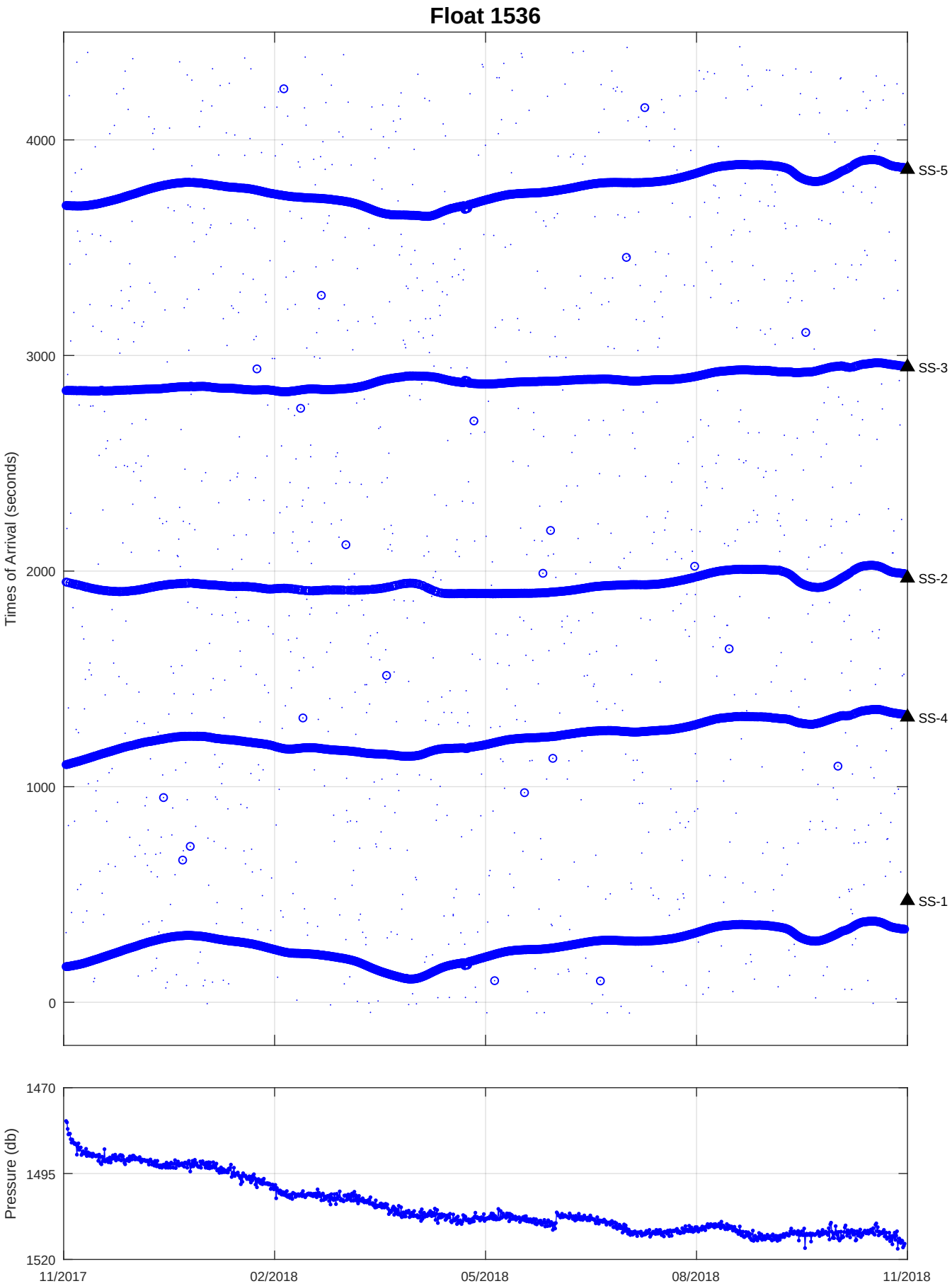

Float 1532
Times of Arrival (seconds)
4000
3000
2000
1000
0
SS-5
SS-3
SS-2
SS-4
SS-1
Pressure (db)
1440
1490
1540
03/2018
06/2018
08/2018
11/2018
01/2019

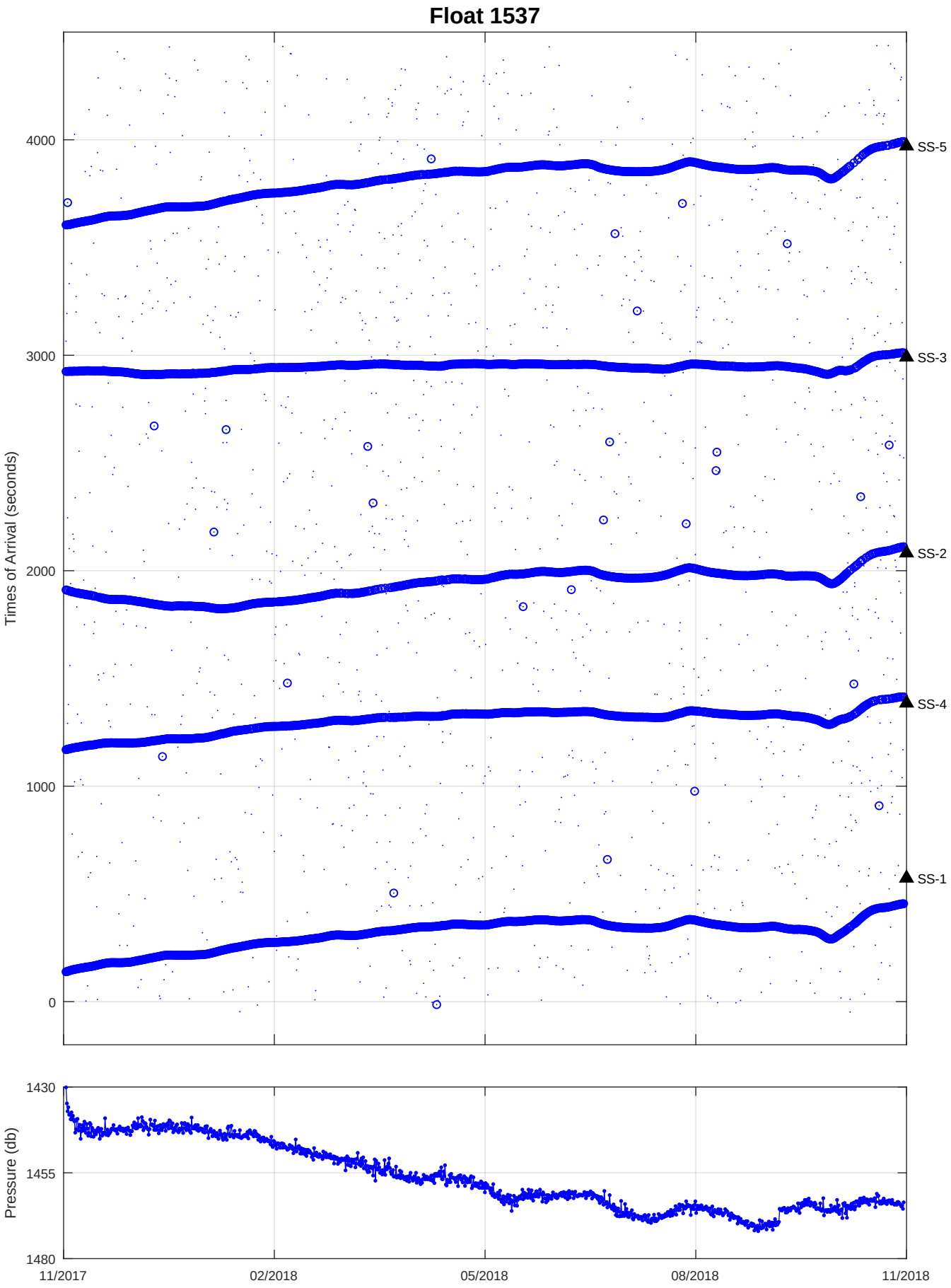

Float 1533
Times of Arrival (seconds)
4000
3000
2000
1000
0
SS-5
SS-3
SS-2
SS-4
SS-1
Pressure (db)
1470
1485
1500
11/2017
02/2018
05/2018
08/2018
11/2018

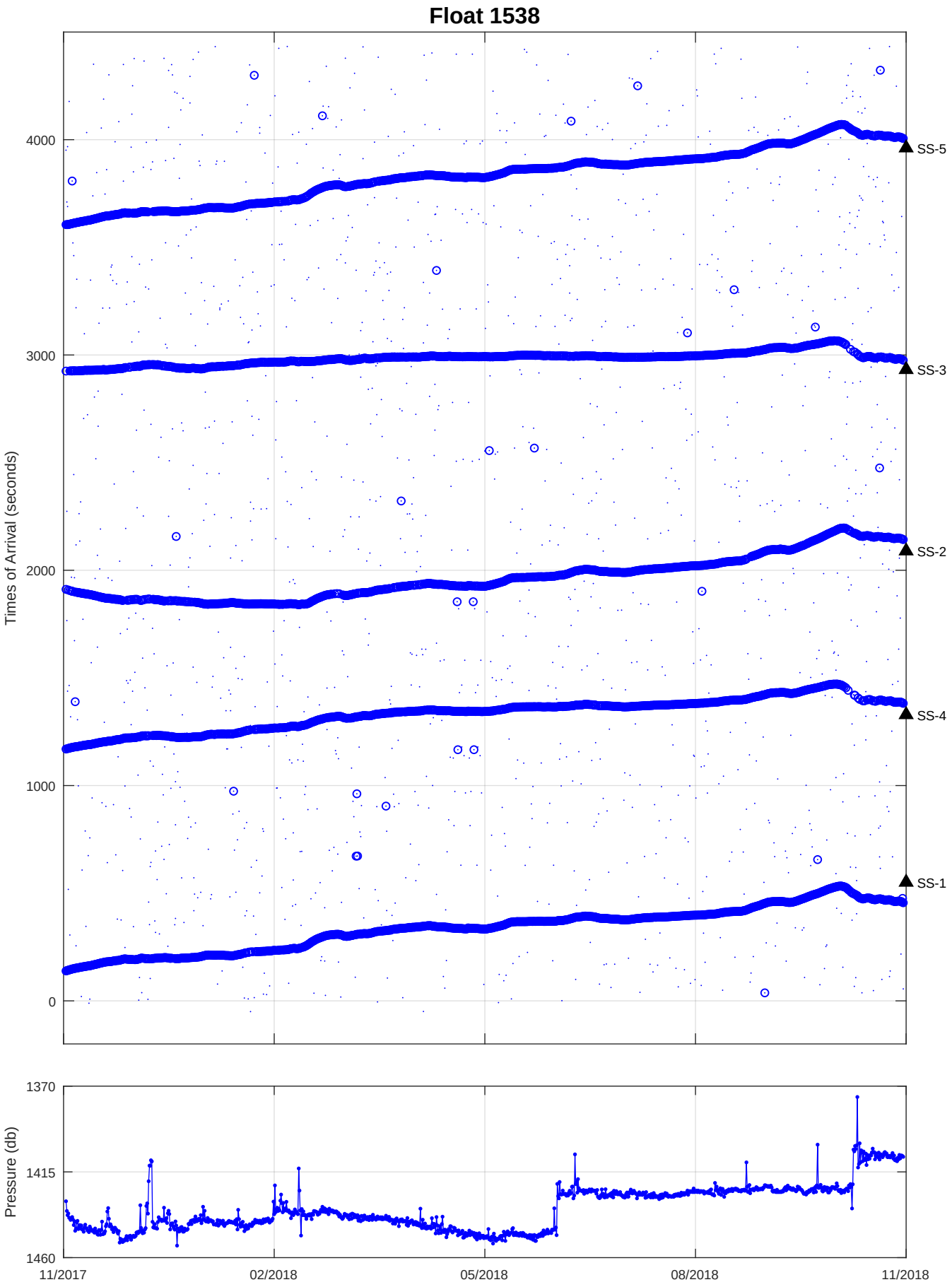

Float 1534
Times of Arrival (seconds)
4000
3000
2000
1000
0
SS-5
SS-3
SS-2
SS-4
SS-1
Pressure (db)
1520
1545
1570
11/2017
02/2018
05/2018
08/2018
11/2018

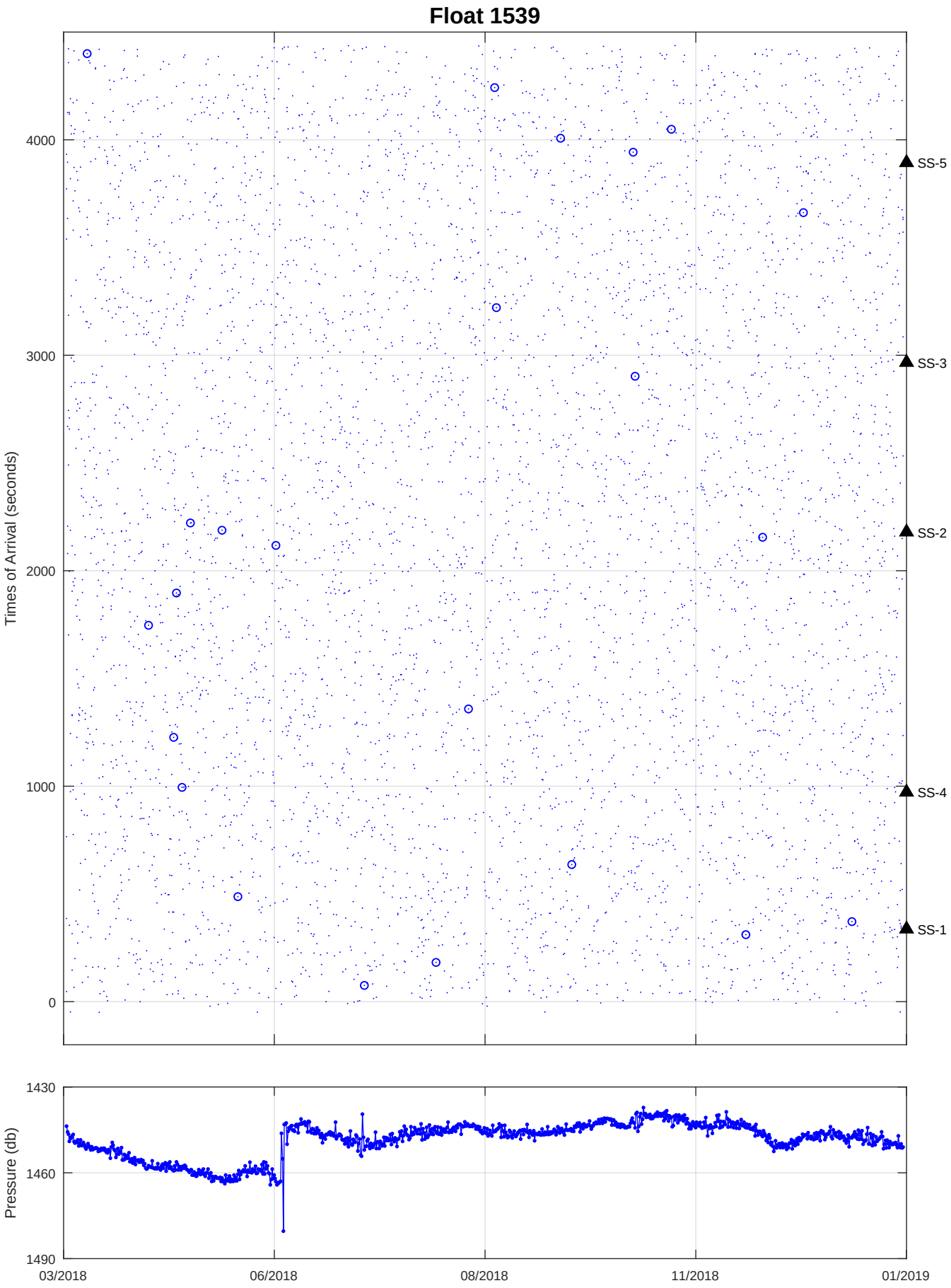
Float 1535


Times of Arrival (seconds)
4000
3000
2000
1000
0
SS-5
SS-3
SS-2
SS-4
SS-1
Pressure (db)
1410
1445
1480
03/2018
06/2018
08/2018
11/2018
01/2019

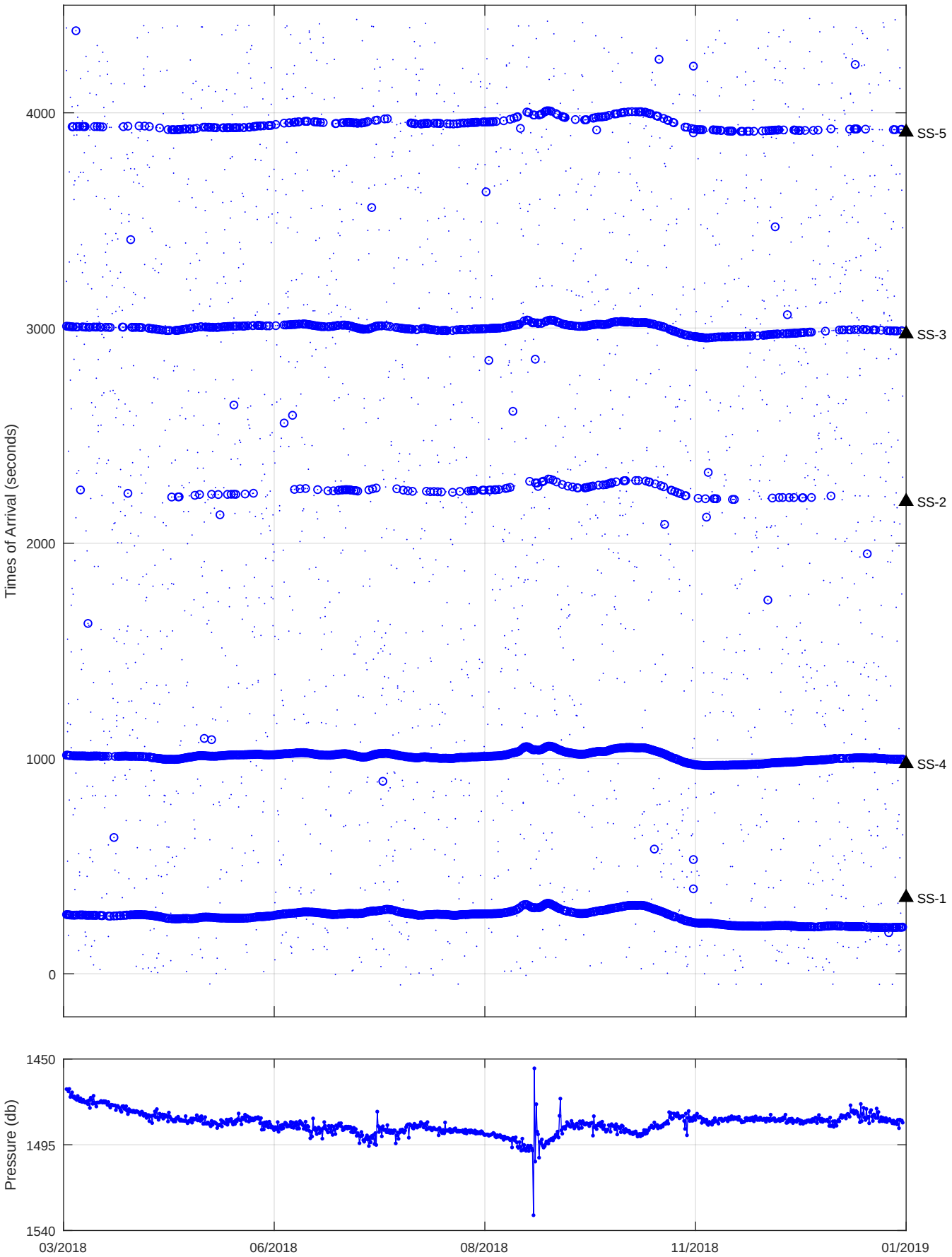

Float 1536
Times of Arrival (seconds)
4000
3000
2000
1000
0
SS-5
SS-3
SS-2
SS-4
SS-1
Pressure (db)
1470
1495
1520
11/2017
02/2018
05/2018
08/2018
11/2018


Float 1537
Times of Arrival (seconds)
4000
3000
2000
1000
0
SS-5
SS-3
SS-2
SS-4
SS-1
Pressure (db)
1430
1455
1480
11/2017
02/2018
05/2018
08/2018
11/2018


Float 1538
Times of Arrival (seconds)
4000
3000
2000
1000
0
SS-5
SS-3
SS-2
SS-4
SS-1
Pressure (db)
1370
1415
1460
11/2017
02/2018
05/2018
08/2018
11/2018


Float 1539
Times of Arrival (seconds)
4000
3000
2000
1000
0
SS-5
SS-3
SS-2
SS-4
SS-1
Pressure (db)
1430
1460
1490
03/2018
06/2018
08/2018
11/2019
01/2019

Float 1540


Times of Arrival (seconds)
4000
3000
2000
1000
0
SS-5
SS-3
SS-2
SS-4
SS-1
Pressure (db)
1450
1495
1540
03/2018
06/2018
08/2018
11/2018
01/2019

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16. Abstract (Limit: 200 words)

This is the final data report for all acoustically-tracked subsurface RAFOS floats deployed for the “Deep Water Dispersion Experiment: RAFOS Float Study in Support of Analysis of Possible Consequences of Large Scale Oil-Spills under Various Scenarios”. This study is part of the larger program “Deep and Shallow Particle Dispersion and Biological Connectivity over the Continental Slope in the Western Gulf of Mexico”, of the Gulf of Mexico Research Consortium (CIGoM). The objective of the DWDE project was to measure and evaluate the ocean circulation at various depths in order to estimate the rates and pathways by which a passive tracer would spread. The experiment consisted of the deployment 93 RAFOS floats and five sound source moorings over the course of five cruises, between June 2016 and January 2019, in the northwestern Gulf of Mexico. The floats were deployed at stacked depths of 300 and 1500 dbar, in sets of 2-4 instruments per station, for calculating dispersion statistics. Mission lengths for the floats were set to ~12 to 18 months. Included in this report are cruise summaries, statistics and notes on sound source and float performance, sound source drift calculations, description of the RAFOS float data processing steps, and figures.

17. Document Analysis a. Descriptors

Gulf of Mexico
floats
dispersion

b. Identifiers/Open-Ended Terms

c. COSATI Field/Group

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